Preliminary Draft

Town of Marana Habitat Conservation Plan

September 2004

Prepared for

Town of Marana, Arizona

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Disclaimer

This document has been prepared to satisfy the requirements of the Town of Marana's 2003 intergovernmental agreement with Arizona Game and Fish Department. This is a preliminary draft Habitat Conservation Plan (HCP) and is not intended for submission to U.S. Fish and Wildlife Service as part of an incidental take permit application. Due to the preliminary nature of this document, there are some portions that do not include all information necessary for a final draft HCP. Any application made by the Town may include any and all portions of this preliminary draft, but will, at a minimum, consist of a revised version of this draft HCP.

This document is intended for review and discussion by the Town of Marana's Stakeholder Advisory Group and Technical Biology Team. Although every reasonable attempt has been made to provide accurate information, the Town of Marana does not guarantee the accuracy of information contained within this draft document.

Any photo-reproductions of this draft HCP must include a copy of this disclaimer.

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A Proposed Prohibited Plant Species List
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SECTION 1

Introduction and Background

This Habitat Conservation Plan (HCP) had been prepared to support the Town of Marana's (Town or Marana) application for an Incidental Take Permit (Permit) in conformance with Section 10 of the Federal Endangered Species Act of 1973 (ESA). Through this HCP, the Town is committing to implement certain actions that will minimize and mitigate the impacts of any take of certain specified species that could occur as a result of planned urban development, and associated capital improvement projects in the Town over the next 25 years.

1.1 Background

The Town of Marana is located in southeastern Arizona. Portions of the Town support cactus ferruginous pygmy-owls (*Glaucidium brasillanum cactorum*), a species currently listed as endangered (62 FR 10730) under the Federal Endangered Species Act. Over half of the Town is in proposed critical habitat for pygmy-owl (68 FR 22353) with additional land included in two proposed Recovery Units (Recovery units #2 and #3) (United States Fish and Wildlife Service [USFWS or Service] 2003).

The Town has been experiencing significant population growth over the past few decades. When the Town incorporated in 1977, it encompassed 6,400 acres and supported 1,512 residents. Between the years 1980 and 1990, the Town's population increased by 521 residents (a 30% increase). From 1990 to 2000, population growth accelerated with an increase to 13,556 residents (over a 500% increase). This population growth has been accompanied by an increase in the incorporated area of the Town. Currently the Town encompasses about 75,263 acres and supports about 17,000 residents. Over the next decade, Marana is expected to become home to more than 40,000 people.

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

Conservation of natural resources has been and continues to be an important consideration for the Town in planning future land use. Therefore, the Town is concentrating future high intensity development in agricultural areas in the western portion of the Town. Less-intensive development is proposed for the northeastern portions of the Town where native vegetation remains and provides habitat for pygmy-owls. Through this HCP, the Town

aims to promote conservation of natural resources while providing for continued growth. The Town seeks to accomplish the following objectives with this HCP:

- Facilitate compliance with the ESA for planned urban development and capital improvement projects;
- Promote achievement of regional economic objectives including the orderly and efficient development of certain lands, while recognizing property rights and legal and physical land use constraints;
- Complement other regional conservation planning efforts such as Pima County's Sonoran Desert Conservation Plan and the City of Tucson HCP project.

1.2 Permit Holder and Permit Duration

The Town of Marana will be the permit holder and will be solely responsible for ensuring implementation of the HCP measures. The permit will be in effect for a period of 25 years from 2005 to 2030. This period encompasses the planned future growth in the Town.

1.3 Permit Area

The permit area includes the 75,263 acres within the incorporated area of the Town and any lands required for implementing the HCP regardless of where these lands are located. Figure 1.3-1 shows the incorporated portion of the Town. The permit area does not include areas that may be annexed by the Town in the future. Areas where mitigation lands may be located are identified in the conservation program.

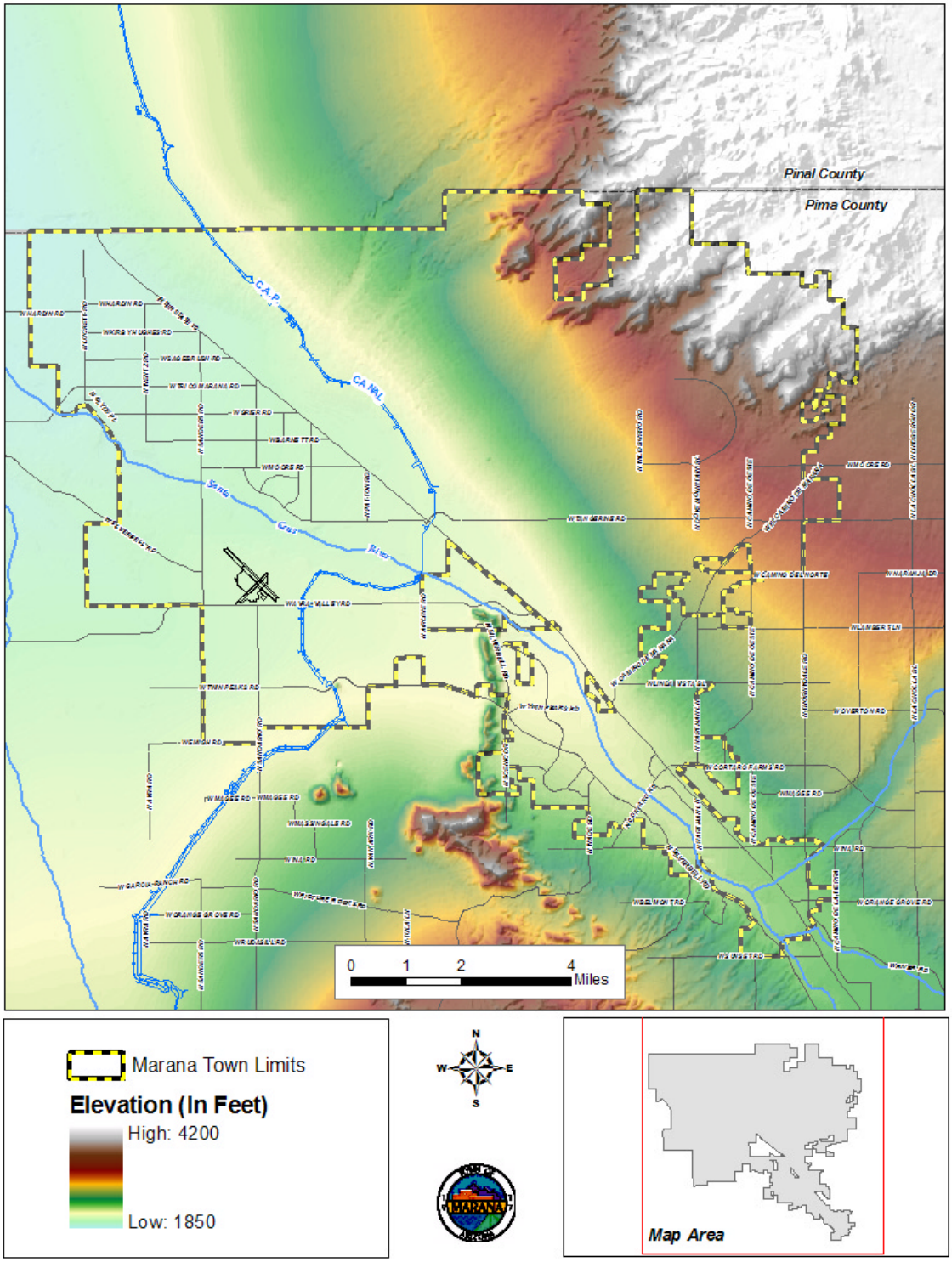

FIGURE 1.3-1
HCP Permit Area (Town of Marana limits) and the area considered in developing the HCP (HCP Planning Area Boundary)

1.4 Species to be Covered by Permit

The Marana HCP covers the six species listed Table 1.4-1. These species, referred to as "covered species" will be included in the Incidental Take Permit if it is issued.

TABLE 1.4-1
Species included in the Marana HCP

Species	Federal Status
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	Endangered
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	Endangered
Burrowing owl (*Athene cunicularia*)	Species of Concern
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallenscens*)	Species of Concern
Ground snake (valley form) (*Sonora semiannulata*)	None
Tucson shovel-nosed snake (*Chionactis occiptalis klauberi*)	None

1.5 Regulatory Framework

1.5.1 Federal Endangered Species Act

The ESA and its implementing regulations prohibit the take of any fish or wildlife species that is federally listed as threatened or endangered without prior approval pursuant to either Section 7 or Section 10(a)(1)(B) of the ESA. 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.@ Federal regulation 50 CFR 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 an incidental take permit, which authorizes nonfederal entities to incidentally take federally listed wildlife or fish subject to certain conditions. Incidental take is defined by ESA as take that is Aincidental to, and not the purpose of, the carrying out of an otherwise lawful activity.@ Preparation of a conservation plan, generally referred to as an HCP, is required for all Section 10(a) permit applications. The USFWS and the National Oceanographic and Atmospheric Administration's Fisheries Service (NOAA Fisheries) have joint authority under the ESA for administering the incidental take program. The NOAA Fisheries has jurisdiction over anadromous fish species, and USFWS has jurisdiction over all other fish and wildlife species.

Section 10(a) also was intended by Congress to authorize the USFWS to approve HCPs for unlisted as well as listed species. Moreover, if an HCP treats unlisted species as if it were already listed, additional mitigation will not be required within the area covered by the HCP upon the listing of that species. As stated by the Conference Committee when Section 10 was added to the ESA in 1982:

> *"The committee intends that the Secretary [of the Interior] may utilize this provision to approve conservation plans which provide long-term commitments regarding the conservation of listed as well as unlisted species and long-term assurances to the proponent of the conservation plan that the terms of the plan will be adhered to and that further mitigation requirements will only be imposed in accordance with the terms of the plan. In the event that an unlisted species addressed in an approved conservation plan is subsequently listed pursuant to the Act, no further mitigation requirements should be imposed if the conservation plan addressed the conservation of the species and its habitat as if the species were listed pursuant to the Act (House of Representatives Conference Report No. 97-835, 97th Congress, 2d Session, p. 30)."*

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 Fed. Reg. 8859).

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 an incidental take 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 nonfederal 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, effects on federally listed plants, and effects on critical habitat. (ESA requires that 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 results in a Biological Opinion prepared by USFWS regarding whether implementation of the HCP will result in jeopardy to any listed species or will adversely modify critical habitat.

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

The Section 10 process for obtaining an incidental take permit has three primary phases: (1) the HCP development; (2) the formal permit processing; and (3) the 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. An HCP submitted in support of an incidental take permit application must include the following information:

- impacts likely to result from the proposed taking of the species for which permit coverage is requested;
- 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;
- alternative actions considered that would not result in take; 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, 2) an Implementing Agreement (IA), 3) a permit application, and 4) 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. USFWS also prepares an Intra-Service Section 7 Biological Opinion; and prepares a Set of Findings, which evaluates the Section 10(a)(1)(B) permit application in the context of permit issuance criteria (see below). An Environmental Assessment or Environmental Impact Statement serves as USFWS=s record of compliance with the National Environmental Policy Act (NEPA) after a 60-day to 90-day public comment period on the document. (see Section 1.5.3). No further NEPA review is required. An Implementing Agreement is required for HCPs unless the HCP qualifies as a low-effect HCP. A Section 10 incidental take 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 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.

1.5.3 National Environmental Policy Act

The issuance of an incidental take permit by the USFWS constitutes a federal action. The NEPA requires that Federal agencies analyze the environmental impacts of their actions (in

this instance, issuance of an incidental take 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. The NEPA compliance is obtained through one of three actions: (1) preparation of an Environmental Impact Statement (EIS); (2) preparation of an Environmental Assessment (EA); or (3) a categorical exclusion (allowed for low-effect HCPs). An EA is typically prepared for moderate-effect HCP with an EIS required for high-effect HCPs. Low-effect HCPs, as defined in the HCP Handbook, are categorically excluded under NEPA. Preparation of an EIS is anticipated for the Marana HCP.

SECTION 2.0

Activities Covered by Permit

Activities to be covered by the Permit include any activities carried out by or authorized by the Town on covered lands (i.e., the Permit Area identified in Section 1.3). These activities include residential, commercial, and industrial development within the Town boundaries and capital improvement projects, including widening or resurfacing of existing roads, and construction of new roads, bridges, and parks. Maintenance activities associated with public infrastructure and HCP implementation activities also will be covered.

2.1 Residential/Commercial/Industrial Development

Over the next 25 years, up to 48,937 acres of land development is planned in the Town of Marana. This planned development will be residential, commercial, and industrial in nature. No expansion of agricultural uses is anticipated.

The Town of Marana General Plan identifies development areas using a range of land use classes including residential (rural, low, medium, high, and mixed density), agriculture, commercial (interstate corridor and airport), and industrial (campus and general). Due to the range of uses permitted within these categories and uncertainty with respect to changes in allowed uses over time, these categories have been simplified into low intensity and moderate to high intensity designations. Moderate and high intensity uses include residential developments with densities greater than one residence per acre (RAC), residential developments that can have more than 30 percent ground disturbance, all areas of planned commercial or industrial development, and agricultural areas. Low intensity uses include rural and low-density residential development, specifically developments with a housing density of one RAC or less, or with ground disturbance of no more than 30 percent. Other low intensity land use categories include vacant/undeveloped properties, mitigation lands, parks and recreation facilities, and a floodway zone. Mitigation lands are areas that developers have or will set aside for the purpose of complying with their individual Section 7 or Section 10 consultations. Parks and recreation facilities range from small, turf-covered neighborhood parks to large regional parks that provided a wide range of uses and may include both developed and undisturbed areas. The floodway zone is designated through the General Plan as a sensitive area with limited development possibilities. Figure 2.1-1 shows the current land uses within Marana. Acreages of current land use and anticipated future development are shown in Table 2.1-1.

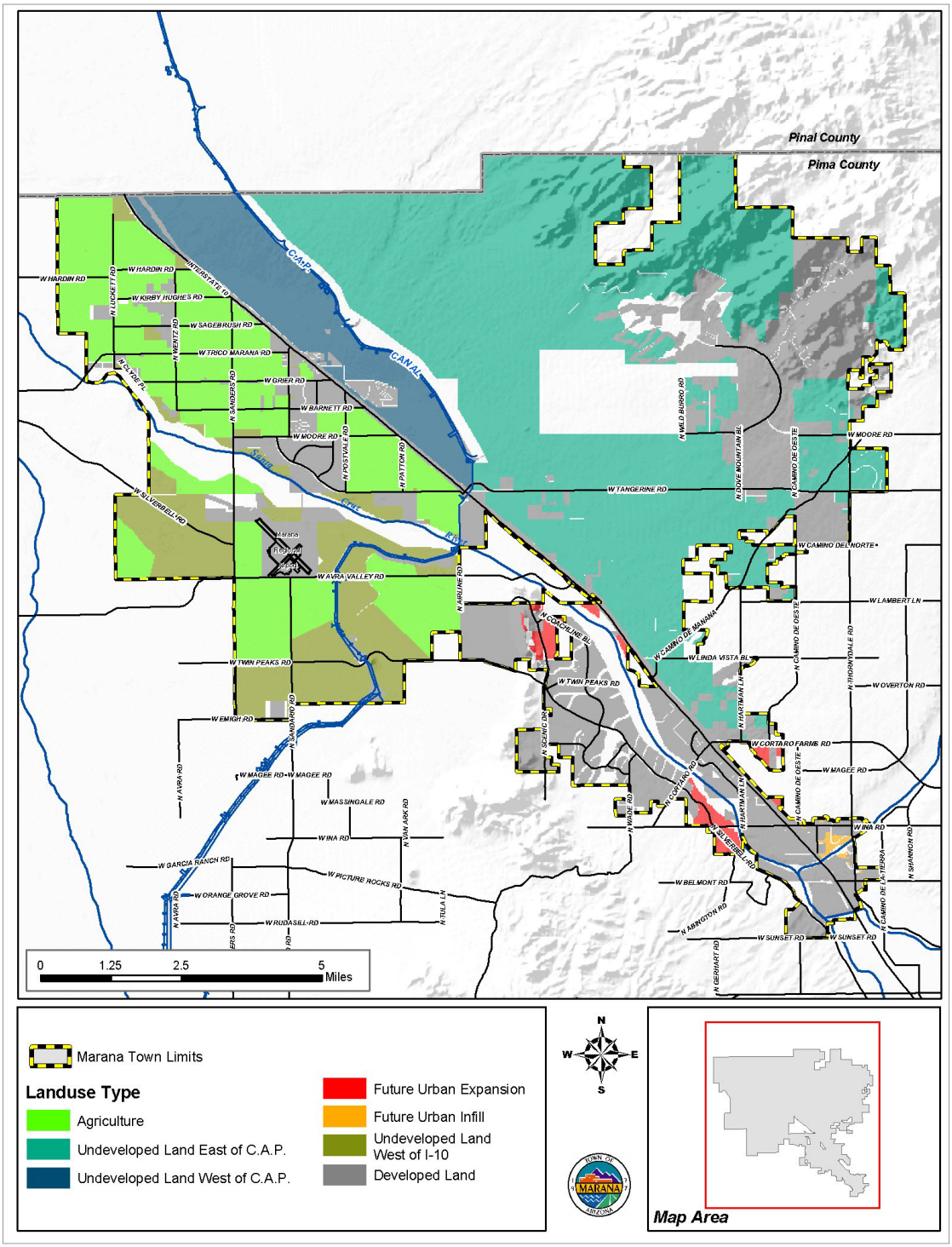

FIGURE 2.1-1
Current land use in areas of proposed future development.

TABLE 2.1-1
Existing and estimated future land use categories and acreages

Land Use Categories	Current Total Acreage	Future Total Acreage	Current State Acreage	Future State Acreage
Agriculture	12,555	0	2,512	0
Development	17,215	66,152	297	29,671 (13,168*)
High/moderate intensity	10,552	36,353	2	9,977
Low intensity	6,663	29,806	148	19,547 (3,044*)
Undeveloped/Vacant	49,644	0	32,765	0
Mitigation land	4,481	5,526	2,408	2,408 (18,911*)
Parks/Recreation	879	1,484	0	0
Floodway	2,995	2,995	950	950
Total high/moderate intensity land use	23,107	36,353	2,514	9,977
Total low intensity land use	64,662	39,811	36,123	22,905 (22,905*)

*Acreage if the Tortolita Preserve is expanded.

The spatial distribution of these planned land uses is tied to current land conditions. The resource conditions in Marana include undeveloped areas (vacant land) with largely native vegetation, an effluent-dominated river and associated riparian habitat, active agricultural lands, and high-density urban areas. Figure 2.1-2 illustrates the location and extent of these various land conditions in the Town with acreages shown in Table 2.1-2.

The intensity of future development has been planned to minimize impacts on natural areas and concentrate high intensity uses in agricultural areas or on otherwise degraded land. In addition to the areas impacted by agriculture in the west-side valley floor and existing urban development in the southern part of the Town, degraded lands include a portion of the Tortolita bajada that has been hydrologically-isolated by the Central Arizona Project (CAP) canal. The area of the Tortolita fan west of the CAP canal does not receive surface flow and is sustained only by direct rainfall. Over time, there has been a reduction in vegetation diversity and volume in this area that will likely continue and, therefore, future urban development has been planned in this area as well.

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

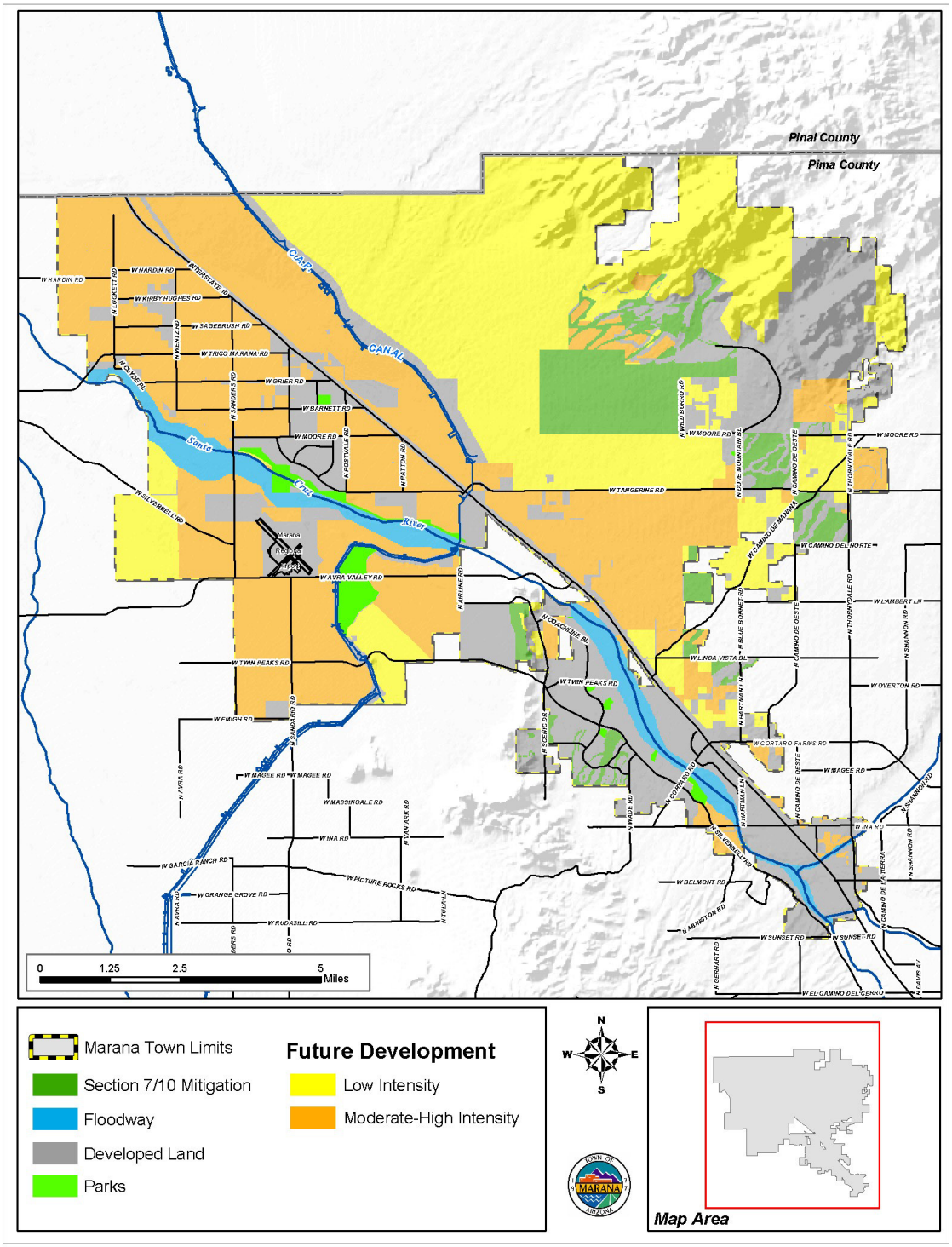

FIGURE 2.1-2
Planned future development in the Town of Marana

TABLE 2.1-2
Estimated future low and moderate/high intensity development by land use area

Current Land Use Category	Current Acreage	Area Planned for Development	
		Low Intensity	Moderate/High Intensity
West			
Agriculture	11,251	531	10,721
Undeveloped	6,123	2,228	3,895
Santa Cruz River			
Floodway	1,466	0	0
East			
Undeveloped and agriculture west of CAP canal	4,441	0	4,441
Undeveloped east of CAP Canal	26,426	20,319	6,107
South			
Urban area infill	Not applicable	0	106
Urban area expansion	Not applicable	136	588

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

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

2.2 Capital Improvement Projects

Growth in population, housing, and employment opportunities during the next 25 years will bring about the need for increased public infrastructure. The Town of Marana will provide new roads, road improvements, and parks, trails, and other recreation opportunities necessary to support the growing community. Most utility service in the Town is provided by other entities. Sewer service is provided by Pima County, water service by the City of Tucson, and power and gas by private companies. Future expansion of these services, therefore, will not be covered in this HCP. Capital improvement projects that will be implemented by the Town and covered by this HCP consist of

- Road construction and improvement
- Public water infrastructure
- Parks and trails
- Airport infrastructure improvements, and
- Maintenance activities of these facilities.

2.2.1 Road Construction and Improvement

The 2001-2025 Transportation Plan Update for the Town of Marana identifies 142 miles of public road projects planned for the next 20 years. These road improvements include the construction of new roads, widening of existing roads, and resurfacing of existing roads. Four existing roads and two future roads will cross the Santa Cruz River; new bridges, and associated grade control, bank protection, and channel modification, are planned as a part of these projects. Table 2.2-3 lists all of the anticipated projects according to type. Descriptions of each of the activities listed in Table 2-3 follow.

TABLE 2.2-3
Future road construction and improvement projects according to type

Project Type	Number of projects	Total extent of projects
Road resurfacing	28	41 miles
Road widening	15	46 miles
New roads	29	55 miles
Bridges	6	301,415 sq. feet
Grade control structures	2	2,700 feet
Bank protection	6	1,210,887 sq. feet
Channel modification	2	2,700 feet

Road Resurfacing

Road resurfacing generally consists of milling the existing surface, adding a new asphalt driving surface, signing, and striping. Resurfacing projects can be accomplished at a rate of 0.1 miles per day with a crew of approximately six. All activities associated with road resurfacing are restricted to currently disturbed areas. Projects may include adding paved shoulders where none currently exist. If shoulders are added to an existing roadway they would generally be from 5 to 8 feet in width. The shoulders would be added in existing graded areas so that no disturbance to potential habitat would occur.

Road Widening

Road widening generally consists of excavation and embankment creation, importing or exporting embankment material, minor changes in horizontal and vertical alignment, drainage improvements, asphalt surfacing, signing, and striping. Other possible improvements include street lighting, traffic signal installations, and landscaping. A 1-mile roadway widening project takes about nine to 12 months. Crew sizes range from 25 to 30 at

any one time. Staging areas are approved by the Town and generally are in currently disturbed locations.

New Road Construction

New road construction generally consists of excavation and embankment creation, importing or exporting embankment material, drainage improvements, asphalt surfacing, signing, and striping where an existing roadway does not currently exist. Other possible improvements include street lighting, traffic signal installations, and landscaping. A 1-mile section of new road requires about six to nine months to construct. Crew sizes range from 25 to 30 at any one time. Staging areas are approved by the Town and usually are in currently disturbed locations.

Bridge Construction Over Water Ways

Bridge construction over water ways will occur where roadway widening, new road construction, rail road crossings, or pedestrian walk paths need to be constructed over existing or future drainage ways. Bridge construction generally consists of the sub-structure and the super-structure. The sub-structure is composed of abutments, piers, and girders. Piers are located in water ways and generally consist of several drilled shafts. The super-structure is composed of the bridge deck. A 500-feet new bridge section takes about six to nine months to construct. Crew sizes for a span of this size range from 25 to 30 at any one time. Staging areas are approved by the Town and usually are in currently disturbed locations and out of water drainage areas.

Bridge Construction Over Transportation Ways

Bridge construction over transportation ways consists of grade separated intersections, overpasses and underpasses. This construction generally is more complex than bridges over water ways due to factors such as traffic control and pedestrian safety. Bridge construction generally consists of the sub-structure and the super-structure. The sub-structure is composed of abutments, piers, and girders. The super-structure is composed of the bridge deck. Construction generally takes about nine to 12 months to complete. Crew sizes range from 25 to 30 at any one time. Staging areas are approved by the Town and usually are in currently disturbed locations and away from traffic and pedestrian activities.

Bank Protection and Channel Modification

Bank protection consists of river bank stabilization along the edges of rivers and washes to mitigate against soil erosion and scour. This consists of, but is not limited to, soil stabilization by dynamic compaction and soil-cement stabilized earth. Bank protection can also be accomplished with the use of geotextiles, gabions, rip-rap lined banks, and shot-crete protection. Construction durations for bank protection varies on the method implemented, and can take from one to nine months for 1 mile of construction. Crew sizes range from 5 to 15 for any given time. Staging areas will be approved by the Town and generally will be at locations that are disturbed and out of the wash or river area.

Channel Creation

Future development in northwest Marana will require the creation of new drainage channels in what is now agricultural land in northwest Marana. Locations and number of

channels are unknown, but the channels will be located in existing agriculture or other disturbed areas.

2.2.2 Public Water Infrastructure Installation

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

New Water Plant Construction

New water plants generally are constructed at sites that are less than two acres in size. Water infrastructure facilities include the installation of reservoirs, both buried concrete and aboveground steel, potable water wells, and booster pumping equipment required to pressurize water service zones. These sites require electrical power and have remote telemetry units and communications equipment to communicate the operational conditions of the sites to the system operators. Construction activities associated with the installation of new water plants include site clearing, block walls, and to minimize visual impacts, the addition of exterior aesthetic treatments such as landscaping is often required. The construction of these facilities requires construction crews of two to 10 people and project duration ranges from three to 12 months.

New Pipeline Construction

New pipeline construction usually follows existing rights-of-way and cleared areas within easements but can include the establishment of new easements over previously undisturbed lands. In the event a pipeline requires installation in uncleared areas, clearing widths are generally limited to 50 feet or less though larger pipelines can require up to 75 feet of clearance. New pipeline construction generally consists of excavations from 3 to 20 feet in depth. Pipeline crossings are typically deeper at wash crossings. Construction crew sizes are usually two to 10 people. Pipelines are bedded and shaded with imported material (sand). Pipeline types are typically PVC, ductile iron, or reinforced concrete. Tracer wires are installed atop the proposed pipelines for future locating. Pipeline trenches are backfilled with screened (6" minus) material and are compacted to 90 to100 percent standard proctor density. Air release valves are installed at high points along the alignments and the pipelines can withstand 40 to 80 pounds per square inch (psi) of pressure.

2.2.3 Parks and Trails

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

Heritage Park

Heritage Park will be located on 29 acres of farmland between the Santa Cruz River and the Gladden Farms community. The focus of the park will be on the heritage and history of agriculture in Marana. Construction and improvement activities in the park will include:

- Agriculture field
- Agriculture facilities consisting of a farmer's market, community garden, ethnobotanical garden, and small crop plots
- Train station and track - The train track will run in a one-half mile loop through the park.
- Non-potable water and agricultural detention basin – The water body that will act as a detention basin within the park.
- Trails - The Santa Cruz River Corridor trail will run through the western portion of the park along the Santa Cruz River.
- Equestrian facilities
- Open space
- Habitat restoration - A portion of the park will be restored to the original native habitat of the area prior to agriculture. The area will be adjacent to the Santa Cruz River floodplain.
- Recreation area, including a ramada, playground and a small train depot
- Heritage Center and Cultural Arts Center
- Parking lots

Silverbell/Cortaro Rd. District Park

The Silverbell/Cortaro Rd. District Park will cover 53 acres and serve as a district park for the Continental Ranch area. Portions of the park will be left as natural open space and a trail system will be installed. Other construction activities include:

- Library (approx. 25,000 square feet)
- Recreation Center (approx. 25,000 square feet)
- 2 soccer/multipurpose fields
- 3 baseball/softball fields
- 2 sand volleyball courts
- 2 basketball courts
- Restrooms
- Parking
- Playground
- Horseshoe pits
- Picnic ramadas with barbeque pits
- Equestrian area (including connector trail to Santa Cruz River and parking area)
- Fenced dog park
- Water tank with interpretive signage

Bureau of Reclamation Regional Park

The Bureau of Reclamation (BOR) Park will encompass 461 acres of vacant and retired agriculture land near the Marana Northwest Regional Airport. As of April 2003, proposed plans for the park include:

- 12 soccer fields
- 4 girls softball fields
- 4 adult softball fields

- 4 little league fields
- 2 high school baseball fields
- Picnic area with playground
- Maintenance area
- Ramada
- 4 restrooms
- Band shell near soccer fields
- 2 paved parking areas and one overflow gravel parking area

With the exception of the horse trailer and overflow parking areas, all proposed park development is north of Avra Valley road. The remainder of the park will be undeveloped open space with an option for further expansion in the future. Expansion will include additional parking and open space.

Santa Cruz River Linear Park

A linear park and trail are planned along the Santa Cruz River near Heritage Park. Approximately 5.75 miles of the Santa Cruz River Trail will be constructed atop existing bank protection and the park will extend out 100 feet on either side of the trail. The remainder of the Santa Cruz River Trail and the Juan Bautista de Anza Historical Trail will be developed by Pima County and is not covered in this HCP.

Trails

In cooperation with Pima County, two trails will be developed in the Tortolita Mountains. The Wild Burro Trail and another as-yet unnamed trail in the Tortolita Mountains will be part of the Pima Master Trails system and will serve as connector trails for the area. According to the Town of Marana "Trail System Master Plan", trail width will be a minimum of 20 feet, paved with asphalt or concrete and will feature restrooms, drinking fountains, storage buildings at 2 to 5 mile intervals along the trail. Both trails will be widened, stabilized, and signage will be installed along the sides of the trails. Trailheads will also be installed at the beginning of each trail.

2.2.4 Airport Infrastructure Improvements

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

Runways and Taxiways

Runway 12L-30R (runway 30), the primary airport runway, will be extended 299 feet to the southeast for a final length of 7,200 feet. Taxiway A, which serves and runs parallel to runway 30, will be extended 299 feet. Net surface area for the runway and taxiway extensions will be 44,850 sq. ft., all of which will be in land already cleared. Avra Valley Rd. will also be realigned 2,600 feet south to accommodate the new runway and taxiway length.

Taxiway C, which connects runway 30 and runway 3, will be widened to 50 feet (from an existing width of 35 feet). The pavement strength of the 12L-30R runway and its associated taxiways A and C will be increased to a pavement strength rating of 150,000 pounds dual wheel gear (DWL).

Runway 3-21 (runway 3) will be extended 499 feet to the southwest of the airport. Taxiway B, which serves runway 3, would be extended the same distance. Net surface disturbance will be 54,890 sq. feet, and the runway will be extended through what is now vacant land and agricultural fields. Pavement strength for runway 3 will also be increased to 30,000 pounds DWL.

To service future air traffic needs, a new runway has been recommended for construction parallel to and southwest of runway 30. Designated 12R-30L, the runway will be 4,700 feet long and 75 feet wide and have a pavement strength of 30,000 pounds DWL. Taxiway D would be built concurrently and would be 4,700 feet by 50 feet. Exit taxiways would also be constructed. Net surface disturbance would be 587,500 sq. ft. for the new runway and taxiway D.

Lighting

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

Hangars, Aircraft Parking Ramps, Auto Parking

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

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

2.2.5 Maintenance activities

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

Road Maintenance

Road maintenance activities are required to keep the roads and associated structures, such as right-of-ways, landscaping, signs, bridges, grade control structures and bank protection in good repair and working condition. Minor improvements undertaken during the normal process of performing these activities also are included. Covered maintenance activities include the following activities relating to the road system and associated facilities:

- Inspection activities
- Pavement rehabilitation

- Right-of-way maintenance, including sign installation, landscaping maintenance, trash pick-up, and grading of road shoulders
- Structure maintenance
- Culvert cleaning

Each of these activities is described below.

Inspection Activities
The Town of Marana continuously inspects its road system to determine where and when maintenance is required.

Pavement Rehabilitation
Pavement rehabilitation is limited to the existing roadbed, and includes sealing of cracks on the road surface, filling in potholes, and patching degraded portions of the road.

Right-of-Way Maintenance
The right-of-way for roads is generally 80 to 120 feet wide, depending on whether it is a major or minor route. The rights-of-way for roads may consist of a clear zone, signage and landscaping. Maintenance activities include sign installation, landscaping maintenance, trash pick-up and grading of road shoulders.

Structure Maintenance
Aside from periodic maintenance of the road surface, regular activities are not undertaken to modify existing bridge pylons or other major infrastructure. Bridges needing structural improvements are replaced rather than repaired. No bridge repair is anticipated outside of the bridge replacement projects discussed in Section 2.2.1

Culvert Cleaning
Culvert cleaning is conducted on an as-needed basis under roads and highways in the Town. Culverts are cleaned using high pressure water to loosen material which is then vacuumed out of the culvert. The material is transported to the local landfill.

Park and Trail Maintenance

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

Other covered maintenance activities include management of open space and trail maintenance. Open space within park areas is maintained through irrigation, routine mowing of grass and trash collection. Weeds are controlled in grassy open spaces of parks with herbicides. Maintenance of trails includes routine trash patrol along trail routes, sign mending and repair of vandalized sites. Trail maintenance will occur on regional park trails as well as the Tortolita Mountain trail system within the Town.

Water Infrastructure Maintenance

Pipeline and Valve Maintenance
Maintenance activities associated with pipelines and valves include valve exercising, marking blue-stakes for main locations, routine hydrant and main flushing, chlorine residual and bacteriological testing, and routine inspections to ensure that the existing

facilities are in good repair and in working condition. These activities are generally performed quarterly by one to two person crews with light trucks, 1-ton or less.

Pipeline and Valve Repairs

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

Airport Maintenance

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

2.3 Activities Not Covered by the Permit

Activities carried out or authorized by public or private parties other than the Town are not covered by this HCP and resulting Permit unless explicitly identified above. With respect to waters downstream and land outside of the Town, covered activities will be specifically restricted to those impacts resulting from Town of Marana operations and facilities on species using those areas and covered in this HCP.

Activities within the Permit Area that are not covered by this HCP include those occurring on: 1) any properties that have received development permits in the form of an approved preliminary plat at the time the Permit is issued and 2) properties that have undergone or are in the process of a Section 7 or Section 10 consultation with the U.S. Fish and Wildlife Service at the time the Permit is issued.

Activities relating to grade control structure maintenance are not covered as grade control structures are replaced rather than repaired. Bank protection maintenance is performed by Pima County Flood Control District and therefore is not covered.

Covered activities do not include the operation and maintenance of facilities used to transmit, treat, distribute, or release water or treated effluent. Activities that are not covered also include the impacts of increased, decreased, or otherwise altered water quality or availability except for those impacts directly resulting from activities carried out or authorized by the Town and having all required federal permits.

2.4 Implementation of the HCP

Any incidental take of covered species that results from activities associated with the implementation of the mitigation measures and monitoring program associated with the HCP are covered under this HCP. These covered activities include management of habitat that is acquired, created or restored in implementing the HCP as well as required surveys and monitoring activities. Mitigation, management and monitoring activities implemented by qualified third parties on behalf of the Town for these purposes also are covered.

SECTION 3

Environmental Setting/Biological Resources

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

The Town can be viewed as encompassing three broad geographic areas defined by the following landform features (Figure 3.1-1):

1. Tortolita Fan,
2. Santa Cruz River Corridor, and
3. Valley (Basin) Bottom.

Each area has a distinctive landform, topography, geology, hydrology, and soil conditions. These abiotic features, along with climate, have a profound influence on the vegetation and wildlife inhabiting each area. As discussed here, the Tortolita Fan includes all mountains, hills with moderate relief, dissected bajadas and fans, non-dissected bajadas and fans, and the drainage ways through these landforms. The upland areas of bajadas and fans associated with the Tucson Mountains in the southern most part of the Town are combined, for general descriptions in this Section with the Tortolita Fan even though they are geographically separated areas. The Santa Cruz River Corridor is defined as the floodway. The floodway is that portion of the floodplain that the Town does not plan to develop and within which future flood events would be constrained. The Valley Bottom area encompasses terraces, non-dissected alluvial plains, and floodplains excluding the Santa Cruz River Corridor and accounts for the remaining land area (Figure 3.1-1).

3.1 Physical Setting

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

3.1.1 Tortolita Fan

The primary landform in this area is the “Fan”, or bajada, which extends over much of the north central and eastern portion of the Town. In general, a bajada forms at the base of a mountain range and extends out onto the floodplain. The bajada is formed by the merging of a series of alluvial fans created by storm water runoff, in this case from the Tortolita Mountains. The sheet flow on this heavily dissected bajada is a powerful erosive force particularly when a watercourse has modified. Modifying a watercourse through development can accelerate down-cutting and affect upstream and downstream conditions, including xero-riparian vegetation. The CAP canal has functionally separated the floodplain

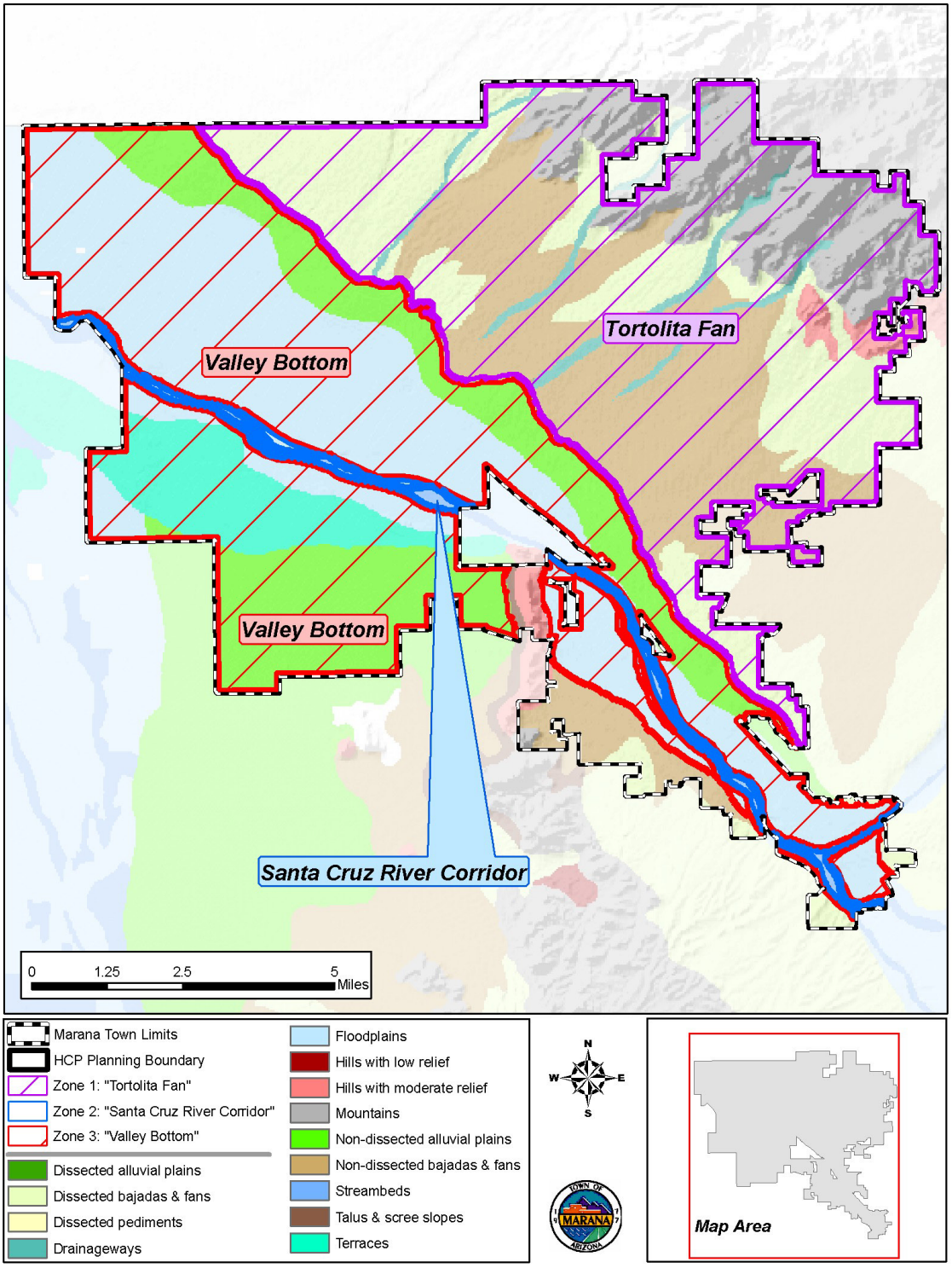

FIGURE 3.1-1
Major landform features of the Town of Marana

at the base of the bajada from the basin bottom and Santa Cruz River (Figure 3.1-1). Slopes on the Fan are gentle, varying from two to five percent, to very steep slopes (greater than 50%) in the Tortolita Mountains.

3.1.2 Santa Cruz River Corridor

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

Except for flood events, all of the water in the Santa Cruz River is discharged from two wastewater treatment plants located at Ina and Roger roads. Approximately 70,000 acre-feet of wastewater are treated annually with approximately 90 percent (63,000 acre-feet) released back into the river (Lacher 1996). At times, very little effluent is in the channel due to daily variations in wastewater releases.

The distance the water travels downstream from the treatment plants is related to the effects of flood events and subsequent infiltration rates. Typically, the river bottom is covered by a dense algal mat that inhibits the infiltration of water. Flood events scour the sediments, which removes the algal layer and increases the infiltration rate. Following these events, the channel geometry stabilizes, and infiltration rates decrease as the algal layer redevelops (Galyean 1996). The algal layer can reform within several days. Consequently, the extent of perennial flow varies from approximately 3.7 miles to over 24.8 miles (Lacher 1996). The Santa Cruz River has experienced major flood events in the recent past. On October 2, 1983 a flow of 65,000 cubic feet per second (cfs) was recorded that widened the river channel, scoured the floodway and removed vegetation. In January 1993, two separate peak flows of 39,000 and 40,000 cfs occurred just 10 days apart (WLB Group 1996).

As the area's need for additional water supplies increases and the value of the effluent increases, more water is likely to be reused. As a result, the volume of wastewater released to the Santa Cruz River, and thereby the flows through the Town, are likely to decrease. The regional water table in the area of the lower Santa Cruz River is about 250 feet below the surface (Lower Santa Cruz Managed Recharge Project Application 2000). In some areas, such as in the vicinity of Avra Valley Road, the regional water table is substantially higher. Nevertheless, the depth to groundwater is great enough to have resulted in a hydraulic disconnection between surface flows in the Santa Cruz River and groundwater.

3.1.3 Valley (Basin) Bottom

The Valley Bottom area (Figure 3.1-1) is relatively flat with alluvial soils deposited from the Santa Cruz River or from runoff from the Tortolita Fan. The surface hydrology of the bottomland has now been separated from both the Santa Cruz River and Tortolita Fan. The area between the CAP canal and Interstate-10 is best considered the lowermost portion of the bajada; however, since it is now functionally disconnected from the outwash from the Tortolita Mountains by the CAP canal, this area is included here as part of the Valley Bottom.

3.2 Climate

The average precipitation at the Tucson Airport is between 11 and 12 inches per year. However, actual precipitation in the Town is variable as a result of elevation differences in the Town. Lowe (1964) estimated that an increase in elevation of 1,000 feet results in a 4 to 5 inches increase in annual precipitation. Thus, the Tortolita Mountains and upper bajada likely receive more precipitation than the Valley Bottom. Precipitation occurs in a bi-seasonal pattern distributed between the summer monsoons and winter storms.

Winter temperatures range from an average low of 38 degrees Fahrenheit (°F) to an average high of 67 °F. In the summer, the average low is 71 °F, and the average high is 101 °F. (National Oceanic and Atmospheric Association [NOAA] 1997).

3.3 Vegetation

3.3.1 Tortolita Fan

Vegetation of the Tortolita Fan is characteristic of the Arizona Upland subdivision of the Sonoran Desertscrub biome. Plant associations of the paloverde-cacti-mixed scrub series cover most of the Fan (Table 3.3-1; Figure 3.3-1). The vegetation of this series has the aspect of low woodland comprised of leguminous trees with an overstory of saguaro cactus (*Cereus giganteus*). Common leguminous trees include foothill paloverde (*Cercidium microphyllum*), velvet mesquite (*Prosopis velutina*), and ironwood (*Olneya tesota*). Typically there are one or more layers of shrubs and perennial succulents. High shrub-layer layer vegetation commonly includes acacias (*Acacia* spp.), desert hackberry (*Celtis spinosa*), graythorn (*Ziziphus obtusifolia*), and prickly pear (*Opuntia* spp.). Lower shrub-layer vegetation often includes creosote bush (*Larrea tridentata*), triangle-leaf bursage (*Ambrosia deltoidea*), and white bursage (*Ambrosia dumosa*). A relatively small portion of the Tortolita Fan is Creosote-Bursage (Table 3.3-1), a more common plant association on the basins of the Southwest Region. Ground cover on the Fan consists of perennial and annual grasses and forbs.

TABLE 3.3-1
Plant association/land cover types of the Tortolita Fan

Plant Association/Land Cover Type	Acres	Percent
Paloverde-Mixed Cacti	29,911	74.0
Developed	5,386	13.3
Shrub-Scrub Disclimax	3,644	9.0
Creosote – Bursage	1,431	3.5
Active Agriculture	45	0.1
Abandoned Agriculture	18	>0.1
Stream Bed	7	>0.1
TOTAL	**40,442**	**100**

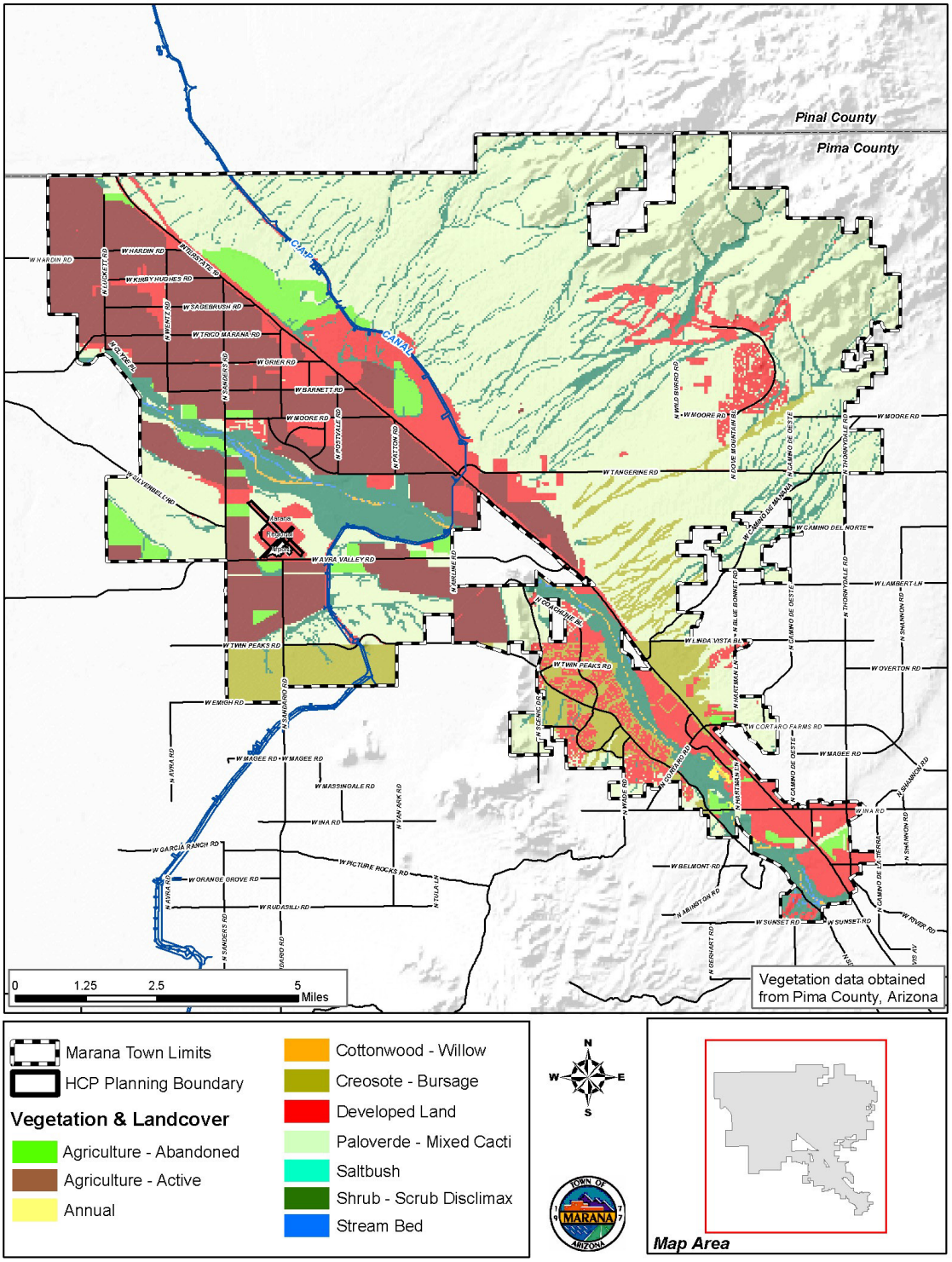

FIGURE 3.3-1
Vegetation and land cover in the Town of Marana

Xero-riparian (e.g., Shrub-Scrub Disclimax) vegetation is well developed in the numerous washes (drainageways) traversing the Fan. These washes often support large trees, commonly ironwood, blue paloverde (*Cercidium floridum*), velvet mesquite, and desert hackberry. Some large washes also support isolated patches of more mesic riparian vegetation that can include Fremont cottonwood (*Populus fremontii*), Goodding willow (*Salix gooddingii*), and seepwillow (*Baccharis salicifolia*).

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

3.3.2 Santa Cruz River Corridor

Baker (2000) conducted a vegetation study focused on the portion of the Santa Cruz River in the Town of Marana. Vegetation was classified at the series and association level (Figure 3.3-2; Table 3.3-2). Based on this study, disturbed areas account for the highest percentage of the land cover (26 percent) and include residential, commercial, and industrial developments, pits, and sand bars. Upland vegetation of Creosote Bush, Desert Saltbush, and Blue Paloverde associations cover 34 percent (876 acres) of the total area. Hydromesic woodlands, in order of prevalence, include Velvet Mesquite, Saltcedar, and Goodding Willow associations and account for approximately 21 percent of the total area. Non-woody hydromesic associations of Burrobush, Desert Broom, and Bermuda Grass cover 16.5 percent (413 acres) of the area (Figure 3.3-2; Table 3.3-2).

The current mesic vegetation of the Santa Cruz River floodway is largely a product of the effluent discharged from the Ina and Roger Road treatment plants and this flow is necessary to maintain the existing hydromesic riparian woodland vegetation. The hydromesic vegetation also is adapted to periodic flooding and can quickly re-establish after a flood event. Vegetation surveys conducted in 1999 showed that the Gooding willow vegetation was approximately 6 years old suggesting that the 1993 floods caused significant removal of riparian vegetation. Baker (2000) attributed a 46-percent loss of willow woodland to the 1993 floods.

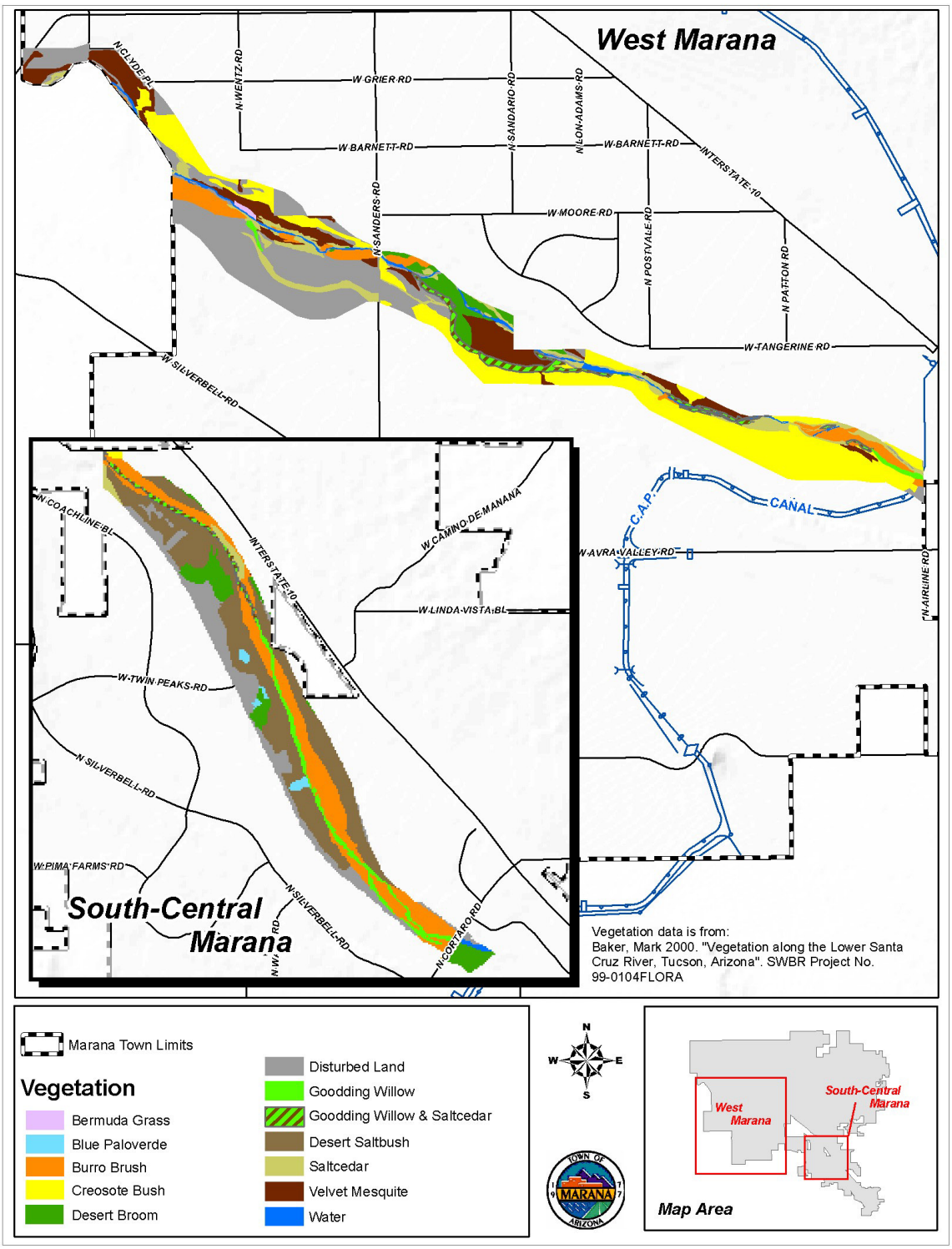

FIGURE 3.3-2
Riparian vegetation of the Santa Cruz River

TABLE 3.3-2
Plant association/land cover type of the Santa Cruz River corridor

Plant Association/Land Cover Type	Acres	Percent
Disturbed	659.3	26.2
Creosote Bush Association	555.8	22.1
Desert Saltbush Association	302.7	12.0
Burrobush Association	281.9	11.2
Velvet Mesquite Association	236.5	9.4
Saltcedar Association	159.9	6.4
Desert Broom Association	127.1	5.0
Goodding Willow/Saltcedar Association	83.1	3.3
Goodding Willow Association	49.4	2.0
Water	48.2	1.9
Blue Paloverde Association	8.5	0.3
Bermuda Grass	3.7	0.2
TOTAL	**2516.1**	**100**

3.3.3 Valley (Basin) Bottom

Well over half of the Valley Bottom area in the Town is in active agriculture, developed (i.e., Marana Northwest Regional Airport, commercial and residential development), or otherwise disturbed (e.g., abandoned agriculture, mining pond) (Table 3.3-3). Although specific crop types and the extent of area in active production vary from year to year, about 15,000 acres are in agriculture with the most common crop being cotton. The vegetation in relatively undisturbed areas is representative of both the Lower Colorado River Valley and Arizona Upland subdivisions of the Sonoran Desertscrub biome. The most widespread native plant associations are those of Paloverde Mixed Cacti, Creosote–Bursage, Saltbush, and Mixed Scrub (Figure 3.3-2).

TABLE 3.3-3
Plant association/land cover types of the Valley (Basin) Bottom

Plant Association/Land Cover Type	Acres	Percent
Active Agriculture	14,864	38.9
Developed	8,209	21.5
Paloverde-Mixed Cacti	7,788	20.4
Shrub-Scrub Disclimax	3,389	8.9
Creosote–Bursage	2,954	7.7
Abandoned Agriculture	879	2.3
Cottonwood-Willow	58	0.2
Stream Bed	55	0.1
Annual	40	0.1
Mining Pond	17	< 0.1
TOTAL	**38,253**	**100**

3.4 Wildlife

Wildlife habitat for any given species can be best described as a combination of vegetation and landform. Landform in turn reflects topography, soils, and other habitat features. The Tortolita Fan is the least disturbed area of the three areas in the Town. Both the Santa Cruz River Corridor and Valley Bottom systems have been highly modified by human activity. Human activity in the area, especially in the Valley Bottom area, extends back over 12,000 years. The wildlife communities present in the three areas reflect these differences in the level of human activity.

3.4.1 Tortolita Fan

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

The xero-riparian vegetation of the washes is an important habitat feature for many species of wildlife by providing relatively more food, cover, and water than the inter-wash areas. These washes also represent habitat linkages because they provide areas of nearly continuous cover or regularly-spaced trees and shrubs that can support wildlife movement within and among habitat patches. In addition, the washes provide shade and cover where

wildlife can escape temperature extremes. The Tortolita Fan supports a high-quality ironwood vegetation community that provides important wildlife habitat, notably habitat for the endangered cactus ferruginous pygmy-owl.

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

3.4.2 Santa Cruz River Corridor

Riparian habitats in the Sonoran Desert have the potential to support a diverse assemblage of wildlife and are regionally important for maintaining biological diversity. However, current habitat conditions in the Santa Cruz River floodway are inadequate to support the full assemblage of wildlife typically associated with riparian systems, particularly systems with perennial water flow. Despite the high variability in water availability in the Santa Cruz River, the diversity of vegetation in conjunction with the presence open water in places provides habitat for a large assemblage of bird species. An important habitat for bird species is the hydromesic woods, especially the relatively widespread Velvet Mesquite Association.

Common reptiles of the Santa Cruz River corridor include common gopher snake (*Pituophis melanoleucus*) and western diamondback rattlesnake (*Crotalus atrox*); and desert spiny, western whiptail (*Cnemidophorus tigris*), side-blotched (*Uta stansburiana*), and zebra-tailed lizards (Stebbins 1985). Amphibians include the southern spadefoot (*Scaphiopus multiplicatus*) and Sonora Desert (*Bufo alvarius*) toads, and bullfrog (*Rana catesbeiana*). Small mammals typical of riparian habitats include the cactus mouse (*Peromyscus eremicus*), desert pocket mouse (*Chaetodipus penicillatus*), and the western harvest mouse (*Reithrodontomys megalotis)* (Hoffmeister 1986). Riparian areas are also important for large mammals for food, cover, and can function as movement corridors. Some large mammals, such as javelina (*Tayassu tajacu*) and coyotes (*Canis latrans*), can adapt to urban development, however, others, such as mule deer (*Odocoileus hemionus*), are less likely to persist in a predominately developed environment.

The lack of consistent, perennial flow downstream of Cortaro Road virtually precludes establishment of fish in this reach of the Santa Cruz River. Only the exotic mosquitofish is known from the area.

3.4.3 Valley (Basin) Bottom

Areas of valley bottom with intact native vegetation support wildlife characteristic of the Lower Colorado River Valley subdivision of the Sonoran Desertscrub biome. These areas, including those that have been disturbed, are important to some species of wildlife, notably the burrowing owl, ground snake, and the Tucson shovel-nosed snake. Soil conditions rather than vegetation are a key habitat feature for many species, especially fossorial

species. Due to the extreme aridity, amphibians are unlikely to occur outside of the Santa Cruz River Corridor. However, the area does support a wide variety of reptiles. Common reptiles include the sidewinder (*Crotalus cerastes*), western diamondback rattlesnake, gopher snake (*Pituophus melanoleucus*), western whiptail, desert iguana (*Dipsosaurus dorsalis*), zebra-tailed lizard, and side-blotched lizard (Stebbins 1985). Common bird species include black-throated sparrow (*Amphispiza bilineata*), cactus wren (*Campylorhynchus brunneicapillus*), northern mockingbird (*Mimus polyglttos*), greater roadrunner (*Geococcyx californianus*), loggerhead shrike (*Lanius ludovicianus)*, white-winged dove, mourning dove (*Zenaida macroura*), and turkey vulture (*Cathartes aura*). Most mammals, particularly rodents, have adapted to high temperatures by living underground in burrows (Turner and Brown 1982). Mammals common to the area include the round-tailed ground squirrel (*Spermophilus tereticaudus*), Merriam's kangaroo rat (*Dipodomys merriami*), and several species of pocket mouse (*Perognathus* spp.), desert cottontail rabbit (*Syvilagus auduboni*), black-tailed jackrabbit (*Lepus californicus*), and coyote (Turner and Brown 1982).

Agricultural areas generally support a depauperate community of wildlife species relative to natural habitats. Typical species in agricultural areas include white-winged dove, mourning dove, northern mockingbird, great-tailed grackle (*Quiscalus mexicanus*), Brewer's blackbird (*Euphagus cyanocephalus*), raven (*Corvus corax*), desert cottontail, and a variety of rodents.

SECTION 4.0

Conservation Program

4.1 Introduction

The Town of Marana is covering six species in its HCP

- Cactus ferruginous pygmy-owl
- Burrowing owl
- Ground snake (valley form)
- Tucson shovel-nosed snake
- Lesser long-nosed bat, and
- Pale Townsend's big-eared bat.

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

This section presents the conservation strategies and monitoring and adaptive management programs for each of the covered species. Each species is individually addressed. For each species, baseline information is presented on the species' status and distribution, life history and habitat requirements, existing population status and habitat conditions in the HCP area, and potential impacts to the species from the proposed covered activities. In consideration of this information, biological goals and objectives of the conservation program are defined for each species. The specific conservation measures the Town would implement to achieve the species specific goals and objectives then are described. A monitoring and adaptive management program complements the conservation measures. Each species' section concludes with an evaluation of the effects of implementing the HCP on the species.

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

4.2.1 Population Status and Ecology

Range and Distribution

The ferruginous pygmy-owl (*Glaucidium brasalianum*) has a range that extends from the southern United States (Arizona and Texas) south to central Argentina (Cartron et al. 2000a). The cactus ferruginous pygmy-owl (CFPO; *Glaucidium brasilianum cactorum*) is the northernmost occurring of several subspecies of the ferruginous pygmy-owl (Cartron et al. 2000a). The subspecies ranges from lowland central Arizona south through western Mexico to the States of Colima and Michoacan, and from southern Texas south through the Mexican States of Tampaulipas and Nuevo Leon (USFWS 2002a).

The current distribution of CFPOs within Arizona is poorly understood. Historically, CFPOs occupied areas of south-central Arizona from New River (about 35 miles 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 miles northeast of Tucson) (USFWS 2003a; Cartron et al. 2000a; Figure 4.2-1). Currently, the Arizona population appears to have a patchy distribution, with most pygmy owls located in one of four general areas: northwest Tucson and southern Pinal County, Organ Pipe Cactus National Monument, the Tohono O'odham Nation, and Alter Valley (Richardson et al., 2000). The species may be extirpated from portions of its historic range, including the lower and middle Gila River, the Santa Cruz River near Tucson, the Rillito Creek, and the Salt River near Phoenix (Cartron et al. 2000c).

Population Status and Threats

Range-wide Population Status and Threats

The CFPO population is divided into four distinct population segments: Texas, eastern Mexico, Arizona, and western Mexico (USFWS 1997). The eastern (Texas and east Mexico) and western (Arizona and west Mexico) populations are separated by the basins and mountain ranges of the Chihuahuan desert in the United States; and by the Sierra Madre Occidental and Oriental ranges and the Mexican Plateau in Mexico (Cartron et al. 2000a).

Federal Status

The endangered status of the CFPO has been controversial and subject to years of litigation. In March 1997, the Arizona population of the CFPO was federally listed as endangered as a distinct population segment (DPS) (USFWS 1997). In January 2001, the National Association of Homebuilders (Homebuilders) sued to vacate the listing on the basis that the DPS designation for the Arizona population was not valid. The District Court, in September 2001, found that the DPS designation, and as a result the listing, was consistent with USFWS policies. Then, in March 2003, the Homebuilders appealed the District Court decision to the Ninth Circuit Court. Five months later, the Ninth Circuit Court declared the USFWS was arbitrary and capricious in listing the Arizona population of the CFPO and remanded the listing back to the District Court for further proceedings (Homebuilders 2003). In June 2004, the District Court left the listing in place and referred the listing back to the USFWS for

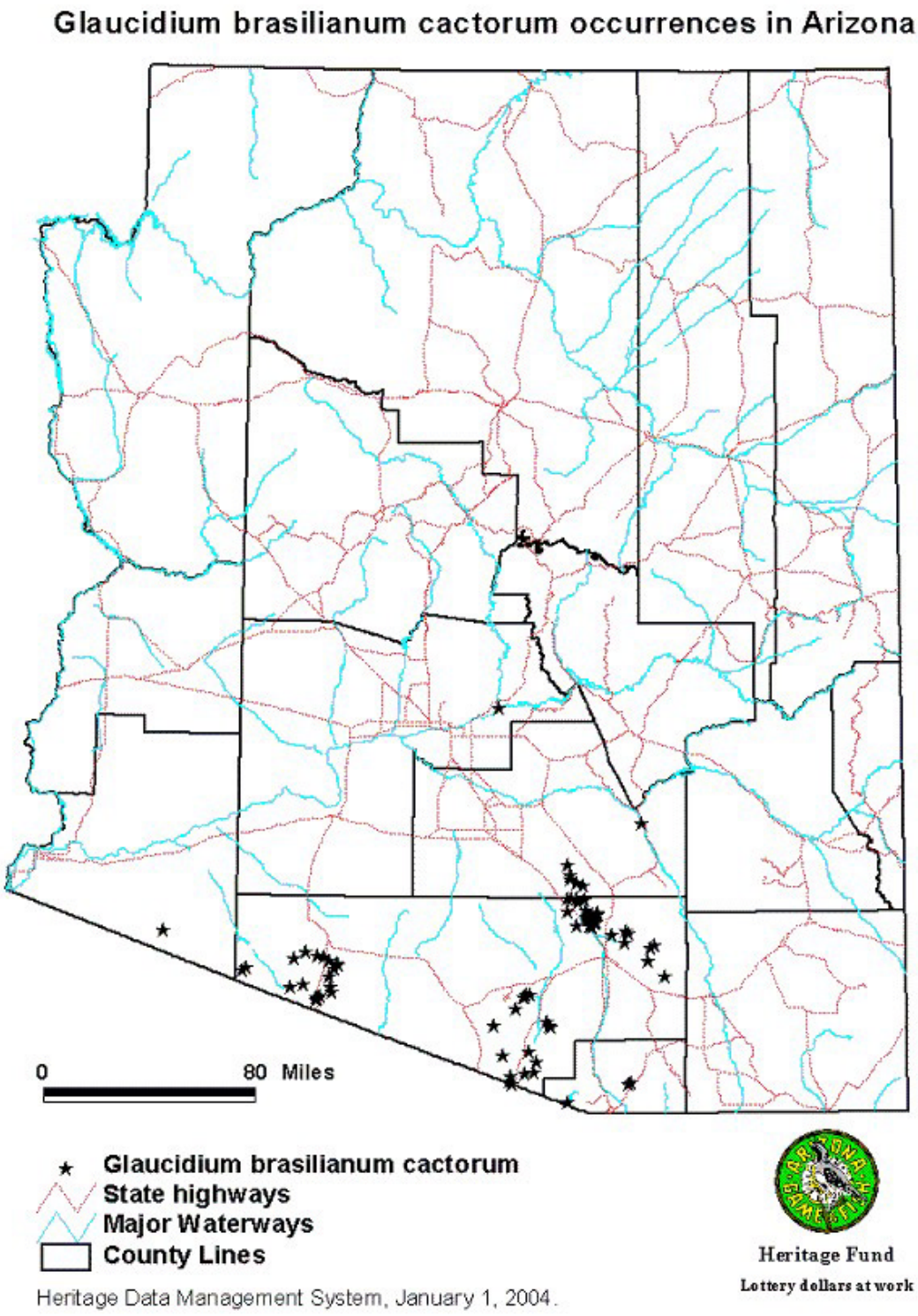

FIGURE 4.2-1.
Historic distribution of pygmy-owls in Arizona

further review based on information gathered since 1997. The USFWS must provide an update of their reconsideration at the end of January 2005 (Homebuilders 2004). In August 2004, the Homebuilders appealed the District Court's June order to the Ninth Circuit Court of Appeals. The legal status of the CFPO continues to be uncertain.

In July 1999, USFWS designated approximately 740,000 acres of critical habitat in Arizona. This designation, along with the listing itself, was challenged in the January 2001 lawsuit described above, in concert with the challenge to the listing. In September 2001, a Federal judge vacated the critical habitat and remanded the designation back to USFWS for a new analysis of economic impacts. In 2003, USFWS re-proposed 1.2 million acres of critical habitat (USFWS 2002). A public comment period for the new proposal extended until June 2003; however, additional work on the critical habitat designation is on hold, pending the outcome of challenges to the CFPO listing.

Texas Population and Status

Although threatened status was proposed for the Texas population of CFPOs, this population was determined to be stable and have a lower level of threat than the Arizona population. Therefore, listing was not found to be warranted (USFWS 1997). One estimate of the CFPO population in Texas suggests that, across Brooks, Kenedy, and Willacy counties, there are 1,308 owls occurring in live oak-mesquite habitat (Wauer et al. 1993). Another study estimates that between 745 and 1,823 individuals occur in Kenedy County alone (Mays 1996).

Mexico Population and Status

At the time of the listing, the USFWS noted that it would continue to review the status of CFPO populations in Mexico and evaluate whether one or more of these populations should be proposed for listing (USFWS 1997). There is limited information about the population status of CFPOs in Mexico. Russell and Monson (1998) suggested that, based on their personal observations and anecdotal information, populations in Sonora, Mexico had not declined. Currently, the CFPO is thought to be relatively abundant in northern Sonora. Flesch and Steidl (2000) looked at CFPO populations just south of the U.S. border throughout the State of Sonora, Mexico. They observed 240 owls (208 males and 32 females) on 191 transects surveyed between February and March 2000; the early part of the breeding season. Another 22 possible detections were made during the surveys. Presence of a pair was documented at only 12 sites, with evidence of pair occupancy at another five sites. In all, only four occupied nest cavities were recorded. In addition to the survey results, another 39 incidental CFPOs detections were recorded. Eight of these owls were female and 31 were male. Three sites had confirmed pair occupancy, with two of these sites having occupied nest cavities. The densities of owls recorded during the survey ranged from 1.8 owls per 10,000 square hectares (ha^2) to 0 owls per 10,000 ha^2, with an average of 0.172 owls per 10,000 ha^2 (Flesch and Steidl 2000).

Arizona Population Status and Threats

There has been a historical decline in the species' range in Arizona (Pima County 2001). The extent of this population decrease is unknown, in part due to the lack of quantified historical records. Historically, CFPOs in Arizona were most commonly reported in cottonwood-mesquite forest and mesquite woodlands. In recent years, CFPOs have been observed primarily in the Arizona Upland subdivision of the Sonoran Desertscrub biome (USFWS 2003b).

The general understanding is that CFPO populations in Arizona began to decline after about 1950, possibly as a result of the increasing loss of riparian habitat caused by lowered water tables, loss of perennial flows in many streams and rivers, invasion of exotic vegetation such as tamarisk (*Tamarix spp*.), and physical changes to river channels, banks, and floodplains. Many riparian areas, however, had not been surveyed prior to being impacted by human activities, so it is possible that the population decline started much earlier in the 20th Century (Johnson et al. 2000).

Formal surveys for the CFPO did not begin in Arizona until 1993. CFPO records in Tucson and Organ Pipe Cactus National Monument date back to 1872 and 1949, respectively; however for many other areas, such as on the Tohono O'odham Nation, little or no historical data exists (Johnson et al. 2000). Even after formal surveys began, the intensity of those efforts was insufficient to provide a good estimate of the number of owls in Arizona. Only after the listing in 1997 did survey efforts increase to the point that a better picture of the population status begin to emerge (Richardson et al. 2000).

The total number of CFPOs in Arizona is still unknown. Survey and monitoring documented 37 adult CFPOs in 1999, 30 in 2000, 36 in 2001, and 29 in 2002, 21 in 2003, and 20 in 2004 (USFWS 2003b; Richardson, pers. com.). It is probable that there are more owls in Arizona, as large tracts of potentially suitable owl habitat have not been surveyed (USFWS 2002a; Richardson et al. 2000). In 1999, the last year for which CFPO survey data was published, 28 owl territories were identified in Pinal and Pima counties. Eleven of these territories had documented breeding activity, with all nests successfully fledging young (although one nest failed after fledging). In total, 32 young successfully fledged in 1999, with 16 known to survive through dispersal (Abbate et al. 2000). Surveys indicate that there are fewer than 50 territories in the State (outside of Tribal lands) (Richardson, pers. comm.).

Three general factors were identified as the basis for the listing of the Arizona population segment: (1) present or threatened destruction, modification, or curtailment of the species habitat or range; (2) inadequacy of existing regulatory mechanisms; and (3) other natural or man-made factors affecting its continued existence. Regardless of uncertainty related to habitat use by the CFPO in Arizona, loss of habitat is generally regarded as the single largest contributor to the decline in owl populations. Anecdotal evidence from both Arizona and Texas indicates that population declines in both locations coincided with the loss of habitat. In addition, relatively large populations of owls can still be found in Texas in areas where owl habitat has been preserved (Johnson et al. 2000).

Although loss of riparian habitat may have been the primary threat to CFPOs in Arizona, currently the loss and fragmentation of upland vegetation from large-scale residential and commercial developments has also been identified as an important threat (USFWS 2003a). Development pressure is seen as the primary threat to conservation of habitat for this species in northwest Tucson (USFWS 2002a). Activities that may affect habitat include: clearing vegetation, indirect effects of urbanization, agricultural encroachment, road-building, high-impact recreation, water diversion or impoundment, channelization of drainages, groundwater pumping, livestock grazing, and hydrologic changes resulting from various land use practices (USFWS 2003a).

Little is known about the rate or causes of mortality in CFPOs or their life expectancy; however, they are susceptible to predation from a variety of species, such as great horned

owls, Harris' hawks, Cooper's hawks, screech-owls, and domestic cats (USFWS 2002a, USFWS 2003a). Other threats include direct and indirect human-caused mortalities, such as collisions with cars, glass windows, fences, and power lines; illegal dumping of toxic waste; and wildfire (USFWS 2003a). In 1999, AGFD reported three instances of adult mortality and 11 instances of actual or presumed juvenile mortality. One adult owl appeared to have broken its neck in a collision with a fence and the other two adults were suspected victims of predation (Abbate et al. 2000). The five confirmed juvenile deaths were from predation (1 juvenile), injuries resulting from wind damage to the nest saguaro (3 juveniles), and unknown causes (1 juvenile) (Abbate et al. 2000). Other natural and human induced factors that could affect the subspecies include low levels of genetic variation, possible contamination from pesticides, potential competition with other birds for nesting cavities, concentration of recreational birding activities at remaining known locations, disease (e.g. Trichomoniasis), and nest predation (USFWS 2002a; USFWS 2003a).

Human activities near nest sites at critical periods of the nesting cycle also can cause CFPOs to abandon their nests (USFWS 2003a). CFPO habitat also can be compromised by the presence of barriers to movement, including roads, interstates, canals, and alterations of functional drainages (Pima County 2001).

Life History

CFPOs are primarily diurnal with crepuscular tendencies, i.e. most activity occurs during daylight hours, with peaks at dawn and dusk (USFWS 2003a). The pygmy-owl typically flies in quick bursts, moving only a short distance from one lookout point to another (Cartron et al. 2000b). Pygmy-owls typically hunt from perches in trees with dense foliage using a perch-and-wait strategy. They also hunt by inspecting tree and saguaro cavities for other nesting birds, and possibly bats. Their diverse diet includes birds, lizards, insects, and small mammals; however, the owls do utilize different groups of prey species on a seasonal basis (USFWS 2002a).

CFPOs are considered non-migratory throughout their range (USFWS 2002a). They are highly territorial with territory sizes between 3 and 57 acres during the breeding season and winter home ranges as large as 279 acres (Pima County 2001; USFWS 2003b). A 280-acre home range is currently considered necessary for CFPOs to meet their life history requirements on an annual basis (USFWS 2003b). Based on telemetry data, it appears that the larger winter range of CFPOs represents an expansion of the breeding territory and does not involve a seasonal shift of territory from one location to another (Richardson, pers. comm.).

CFPOs typically nest as yearlings and both sexes breed annually thereafter. Territories normally contain several nest-roost cavities from which a responding female selects a nest. Hence, cavity density could be a fundamental criterion for habitat selection (USFWS 2003a).

In Arizona, the courtship and nesting period runs from February to May (USFWS 2003a; USFWS 2003b). Clutch sizes range from 3 to 7 eggs (Pima County 2001). One clutch per year is typical (USFWS 2003a); however, a second clutch may be laid if the first one fails (Pima County, 2001). Juveniles typically disperse from natal areas between July and August and do not appear to defend a territory until September. Direction of dispersal appears to be random (USFWS 2003a) and a juvenile CFPO has been documented dispersing over 100

miles (AGFD, pers. comm.). Once dispersing male CFPOs settle in a territory, they rarely move out of their home range. Unpaired females may continue to move until the subsequent breeding season (USFWS 2002a). CFPOs exhibit a high degree of site fidelity once territories and home ranges have been established (USFWS 2002a). Behaviorally, the option to seek alternative areas outside of the home range appears limited, particularly for males (USFWS 2003b).

Habitat Requirements

The habitat requirements of the CFPO are not fully understood. Habitat use by the pygmy-owl varies from Arizona to Texas to Mexico. In Texas, they are typically found in coastal-plain oak associations, mesquite bosques, and Tamaulipan thornscrub. In eastern Mexico, they occur in lowland thickets, thornscrub associations, riparian woodlands, and second-growth forests. The CFPO, in western Mexico, is commonly found in Sonoran desertscrub, Sinaloan thornscrub, Sinaloan deciduous forest, riverbottom woodland, cactus forests, and thornforests. As discussed below, in Arizona, habitat use has included cottonwood and mesquite riparian woodlands, upland Sonoran desertscrub, and semidesert grasslands.

Although the plant communities in Texas and Arizona differ, their similarities may help identify those characteristics most significant for the pygmy-owl. The CFPO is often associated with thickets and thicket edges in Texas and densely foliated non-native landscape vegetation in Arizona. Use of these associations could indicate that vegetation structure, rather than composition, is a critical factor in determining the preferred habitat of the owl. Another similarity between these diverse communities is the presence of thorny bushes (Cartron et al. 2000a).

In Arizona, CFPOs historically were most commonly reported in cottonwood-mesquite forest and mesquite woodlands. These mesic riparian forests and associated mesquite woodlands have been nearly eliminated in southern Arizona over the last 100 years, and the reduction of these habitats is thought to have caused a decline in owls over that period (USFWS 2002a). There is some question as to whether the CFPO was exclusively associated with riparian habitat. Early naturalists in Arizona tended to focus their efforts along rivers, so it is possible that the tendency for owls to be documented in riparian areas is primarily an artifact of where survey and collection work took place (Johnson et al. 2003). Advocates for this historic CFPO-riparian association note that numerous cross-country expeditions crossed the south and central portions of Arizona without reporting the presence of pygmy-owls. In the late 1800s, noted ornithologists Charles Bendire and George Breninger made a distinction between elf owl nesting habitat (in upland saguaros) and pygmy-owl nesting habitat (in riparian cottonwoods and mesquites). There are, however, published historic records (1920s to 1950s) of pygmy-owls in areas with no permanent water source (Johnson et al. 2003). The lack of extensive and quantified historical records makes it unlikely that the debate will ever be fully settled (Richardson, pers. comm.).

In recent years, CFPOs have been primarily found in the Arizona Upland Subdivision of the Sonoran Desertscrub biome. The Arizona Upland Subdivision is described as a low woodland of leguminous trees with an overstory of columnar cacti and with one or more layers of shrubs and perennial succulents. Over the past several years, owls also have been observed in riparian and xeroriparian (dry washes) areas and in semidesert grasslands (USFWS 2003b).

The primary constituent elements of CFPO habitat have been identified as:

1) elevations below 4,000 ft. within the biotic communities of: Sonoran riparian deciduous woodlands; Sonoran riparian scrubland; mesquite bosques; xeroriparian communities; tree-lined drainages in semidesert, Sonoran savanna, and mesquite grasslands; and the Arizona Upland and Lower Colorado River subdivisions of the Sonoran desertscrub

2) nesting cavities in trees including, but not limited to, cottonwood, willow, ash, mesquite, palo verde, ironwood, and hackberry with a trunk diameter of 6 inches or greater (measured at 4.5 ft. from the ground), or large columnar cactus such as saguaro or organ pipe greater than 8 ft.;

3) multi-layered vegetation (presence of canopy, mid-story, and ground cover) provided by trees and cacti in association with shrubs such as acacia, prickly pear, desert hackberry, graythorn, etc., and ground cover such as triangle-leaf bursage, burro weed, grasses, or annual plants;

4) vegetation providing mid-story and canopy-level cover in a configuration and density compatible with pygmy-owl flight and dispersal behaviors; and

5) habitat elements configured and human activity levels minimized so that unimpeded use, based on pygmy-owl behavioral patterns, can occur during dispersal and within home ranges (USFWS 2002a).

Studies of habitat use in Texas suggest that important habitat characteristics include moderate to dense understory cover (anywhere from 50% to 100%), the presence of trees large enough to hold cavities, and fewer small trees (Proudfoot et al. 2000). In Arizona, nest sites tend to have a higher degree of canopy cover and higher vegetation diversity than random sites (USFWS 2003a). Relatively dense understory cover could be important for foraging and survival of fledglings (Cartron et al. 2000a) as well as providing protection from extreme climatic conditions (Cartron et al. 2000b).

Preliminary studies suggest that CFPOs in northwest Tucson use areas with relatively high levels of structural diversity in the suburban/urban interface. Areas of highest concentration of CFPOs are commonly characterized by semi-open or open woodlands, often in proximity to forests or patches of forest. Although CFPOs occupy the same general area year-round, the size of area used and the composition of vegetation may vary among seasons (USFWS 2003a).

Pygmy-owls are obligate cavity nesters, meaning that they almost exclusively utilize natural cavities or cavities created by other species (Cartron et al. 2000 b). Historically, CFPOs in Arizona used cavities in cottonwood, mesquite, ash trees, and saguaro cacti for nest sites (USFWS 2002a); although some evidence suggests that mesquite (a hardwood species) is less readily excavated by other species and, therefore, is less frequently used in riparian areas than softwood trees (Cartron et al. 2000b). Recently (1996 to 2002) all but two known nest sites were in saguaro cacti. Of the two non-saguaro nests, one was in an ash tree and the other in a eucalyptus tree.

The general conclusion from these studies is that, in order to support successful reproduction and rearing of young, home ranges should include trees and cacti of adequate size to provide cavities for nest sites and that are in proximity to foraging, roosting,

sheltering, and dispersal habitats. Further, adequate cover is needed for protection from climate and predators, and in an appropriate configuration in relation to the nest site.

Some preliminary investigations have been done to determine the degree of development that is found within the home ranges and/or breeding territories of CFPOs. In 2001, 83 percent of known CFPO sites were in undeveloped areas with very little human activity and 17 percent of sites were in areas with some level of low-density development. No CFPOs have been documented in high-density commercial or residential developments. CFPO experts on the Recovery Team calculated the level of vegetation disturbance within the estimated home range (280 acres) at each nest site. The average percent disturbance was calculated to be 23 percent. More recent information from an analysis completed by the AGFD showed an overall disturbance of 33 percent within breeding home ranges. There appears to be a difference in the tolerance of breeding versus non-breeding CFPOs to the level of vegetation disturbance (Richardson, pers. comm.).

Pygmy-owls require habitat linkages, within and among territories, for movement and dispersal. Habitat linkages consist of continuous cover or patches of trees and large shrubs spaced at regular intervals, to provide concealment and protection from predators and mobbing. These areas also provide shade and cover to moderate temperature extremes (USFWS 2003b).

Free-standing water does not appear to be necessary for the survival of CFPOs. Owls have never been observed directly drinking water; it is likely they meet much of their biological water requirements through the prey they consume (USFWS 2003b).

4.2.2 Existing Conditions

Population in and near the Town

While the total number of CFPOs in Arizona is unknown, there is less uncertainty with respect to the CFPO numbers in and around Marana than for other areas in Arizona . The northwest Tucson and southern Pinal county area has been the most intensely surveyed of any potentially suitable CFPO habitat in the State (Richardson et al. 2000). As a result.

The AGFD surveyed portions of the potential CFPO habitat within Marana in 2003 and 2004. In addition, because the CFPO is federally listed, surveys have been conducted at the request of private developers and local governments as part of their effort to comply with ESA requirements. Currently, there are three known occupied territories in Marana. All three territories are held by unpaired males and no nesting was detected during 2003 or 2004 (AGFD, unpublished). Since 1995, a total of 12 CFPO territories have been in the Marana planning area.

In addition to low-density urban areas and Sonoran desertscrub northwest of Tucson, owls have been detected in the

- Tucson Mountains (1998, 1 owl) and just east of this range
- Organ Pipe Cactus National Monument (every year since 1993, with nesting documented in 1998 and 1999)
- Tohono O'odham Nations (several owls), and
- Altar Valley (several owls) (Pima County 2001).

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 2003b).

Habitat in and near the Town

Three different models have been developed to delineate potential habitat for the CFPO:

- critical habitat,
- draft recovery areas, and
- the Sonoran Desert Conservation Plan habitat model.

Habitat in the Town, as predicted by these three models, is described below.

Proposed Critical Habitat

The areas proposed as critical habitat are intended to:

- protect known locations of CFPOs,
- include habitat linkages that allow movement and dispersal among the areas supporting owls, and
- maintain habitat through which CFPOs can move between Mexico and the northern portion of the Arizona range.

Critical habitat was developed to include recent (since 1997), verified owl sites; areas below 4,000 ft. elevation that include one or more primary constituent elements related to vegetation; areas included in the average straight-line dispersal distance (5 miles) from nest sites; and 4 of the 5 Special Management Areas identified in the draft Recovery Plan (described below). All areas of proposed critical habitat fall within the maximum dispersal distance (21.8 miles) from recent, verified owl locations, are below 4,000 ft. elevation, and include one or more primary constituent element (USFWS 2003a). The Town encompasses 24,172 acres of proposed critical habitat for the pygmy-owl (Figure 4.2-2).

Draft Recovery Plan

The draft Recovery Plan identifies eight recovery areas (RAs) for the CFPO. These areas represent an interconnected system of habitat developed based on:

- recent, verified locations of owls,
- more recent historical locations, and
- habitat with the best chance of supporting owl breeding and dispersal (specifically, Arizona Upland desertscrub, xeroriparian wash vegetation communities, and where appropriate, mesic riparian vegetation).

The RAs include some areas that are not considered to be currently occupied (i.e. areas more than 21.8 miles from recent, verified locations). Within some RAs, Special Management Areas (SMAs) were identified that need special management because of current or potential threats to the recovery of the CFPO (USFWS 2003a). There are 36,960 acres of recovery areas in the Town of Marana (Figure 4.2-3).

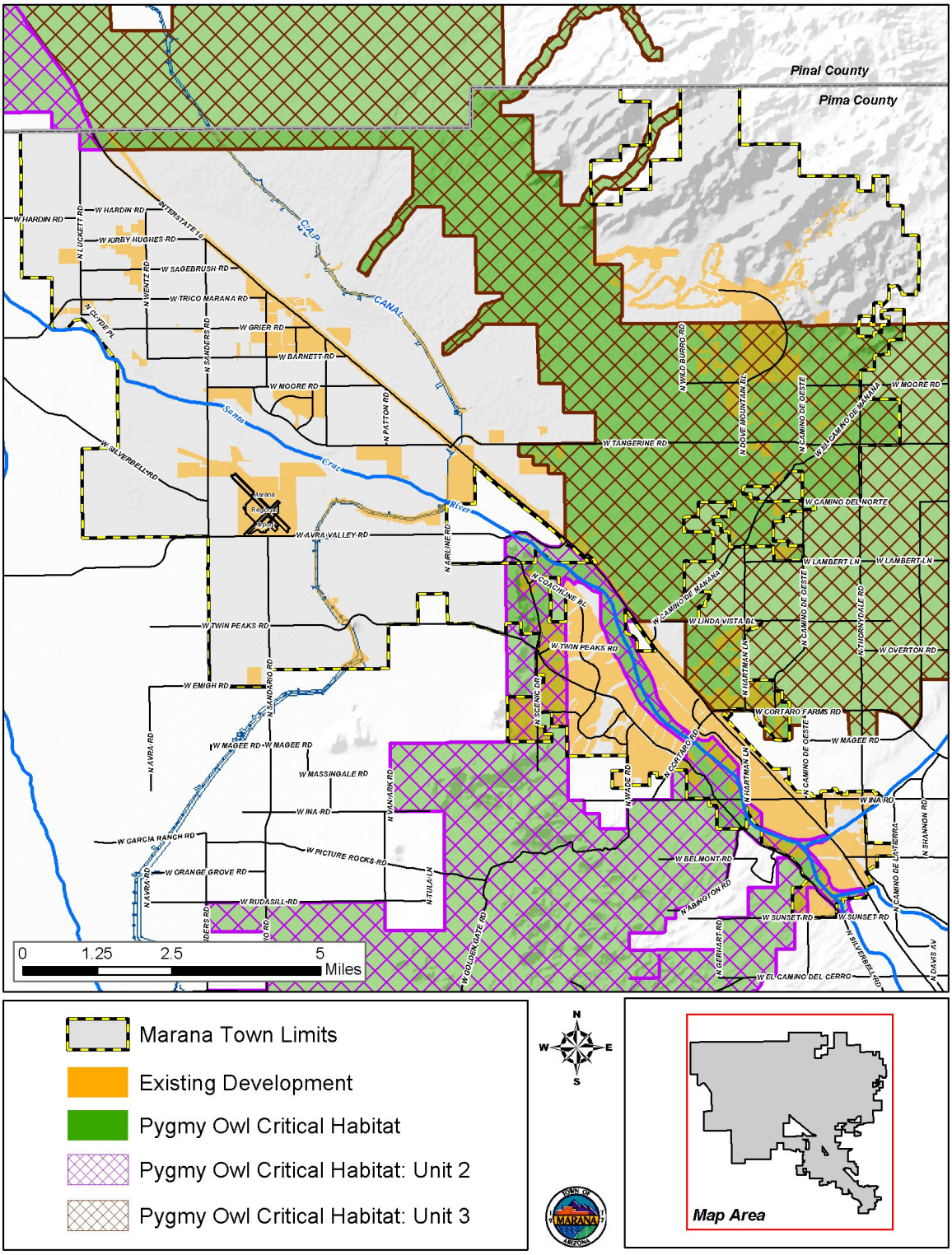

FIGURE 4.2-2.
Proposed Pygmy-Owl Critical Habitat in Marana with Units Indicated.

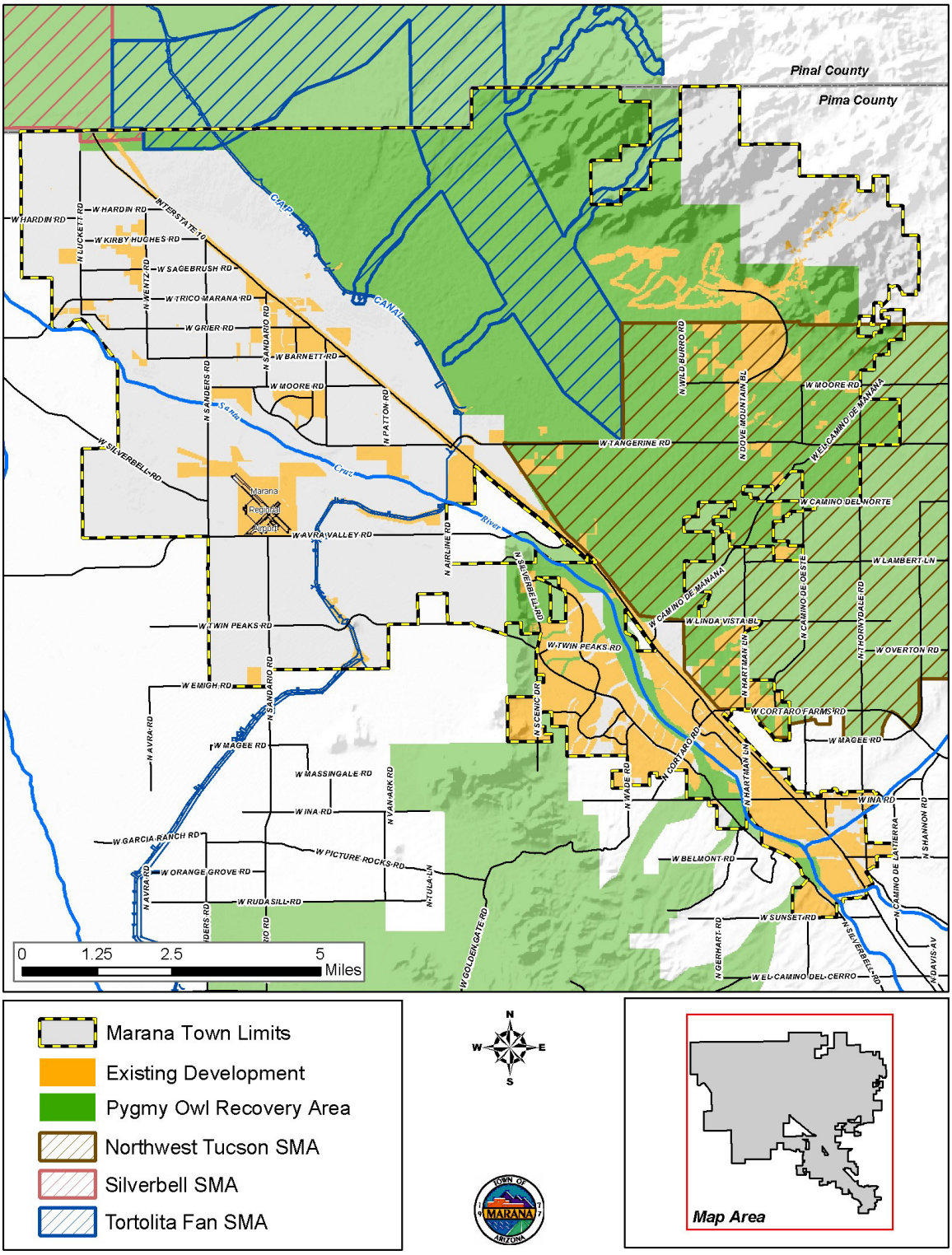

FIGURE 4.2-3.
Draft Pygmy-Owl Recovery Areas in Marana with Special Management Areas Indicated.

Sonoran Desert Conservation Plan Habitat Model

The SDCP habitat model for CFPO was based on four primary components:

- elevation,
- vegetation,
- presence of perennial or intermittent streams, and
- landform characteristics (Pima County 2001).

The habitat value of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provide no habitat value and 3 indicating that the category provided high habitat value. The four variables were combined to provide an overall habitat value. Table 4.2-1 shows the specific categories of the four variables considered to provide habitat for burrowing owls and their habitat value ratings.

Using this habitat model, 37,100 acres of high potential habitat is predicted to occur in Marana (Figure 4.2-4). Much of the potential habitat is in the Tortolita fan, which is considered to be of value to the proposed reserve system of the SDCP and a critical landscape linkage for the owl (Pima County 2001).

TABLE 4.2-1
Value ratings for characteristics of the variables used in the cactus ferruginous pygmy-owl habitat model in the SDCP

Variable/Category	Value Rating
HYDROLOGY	
Intermittent stream	2
Adjacent habitat within ½ mile of intermittent stream	1
Perennial stream	2
VEGETATION	
Sonoran Riparian Woodland Xero-riparian mesquite (124.7)	3
Scrub-Grassland Mixed grass-scrub (143.15)	1
Scrub-Grassland Xero-riparian biome (143.10.XR)	1
Sonoran Desertscrub Upland Paloverde-mixed cacti (154.12)	3
Sonoran Desertscrub Xero-riparian Paloverde-mixed cacti (154.12XR)	3
Sonoran Desertscrub Urban Paloverde-mixed cacti (154.12U)	2
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian biome (223.20)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian cottonwood-willow (223.21)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Meso-riparian mixed broadleaf (223.22)	3
Interior Southwestern Riparian Deciduous Forest and Woodland Urban biome (223.20U)	2
Sonoran Riparian and Oasis Forests Meso-riparian mesquite (224.52)	3

TABLE 4.2-1
Value ratings for characteristics of the variables used in the cactus ferruginous pygmy-owl habitat model in the SDCP

Variable/Category	Value Rating
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53)	3
Sonoran Riparian and Oasis Forests Urban mesquite (224.52U)	2
Sonoran Riparian and Oasis Forests Meso-riparian cottonwood-willow (224.53U)	2
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian biome (234.70)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian mixed scrub (234.71)	1
Sonoran Deciduous Swamp and Riparian Scrub Meso-riparian saltcedar disclimax (234.72)	1
SLOPE	
0 to 2%	1
2 to 5%	1
ELEVATION	
195 to 400 meters	1
401 to 600 meters	2
601 to 800 meters	2
801 to 1000 meters	2
1001 to 1200 meters	2
LAND FORM	
Drainageways	2
Floodplains	2
Terraces	2

Source: Recon (2002) Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan.

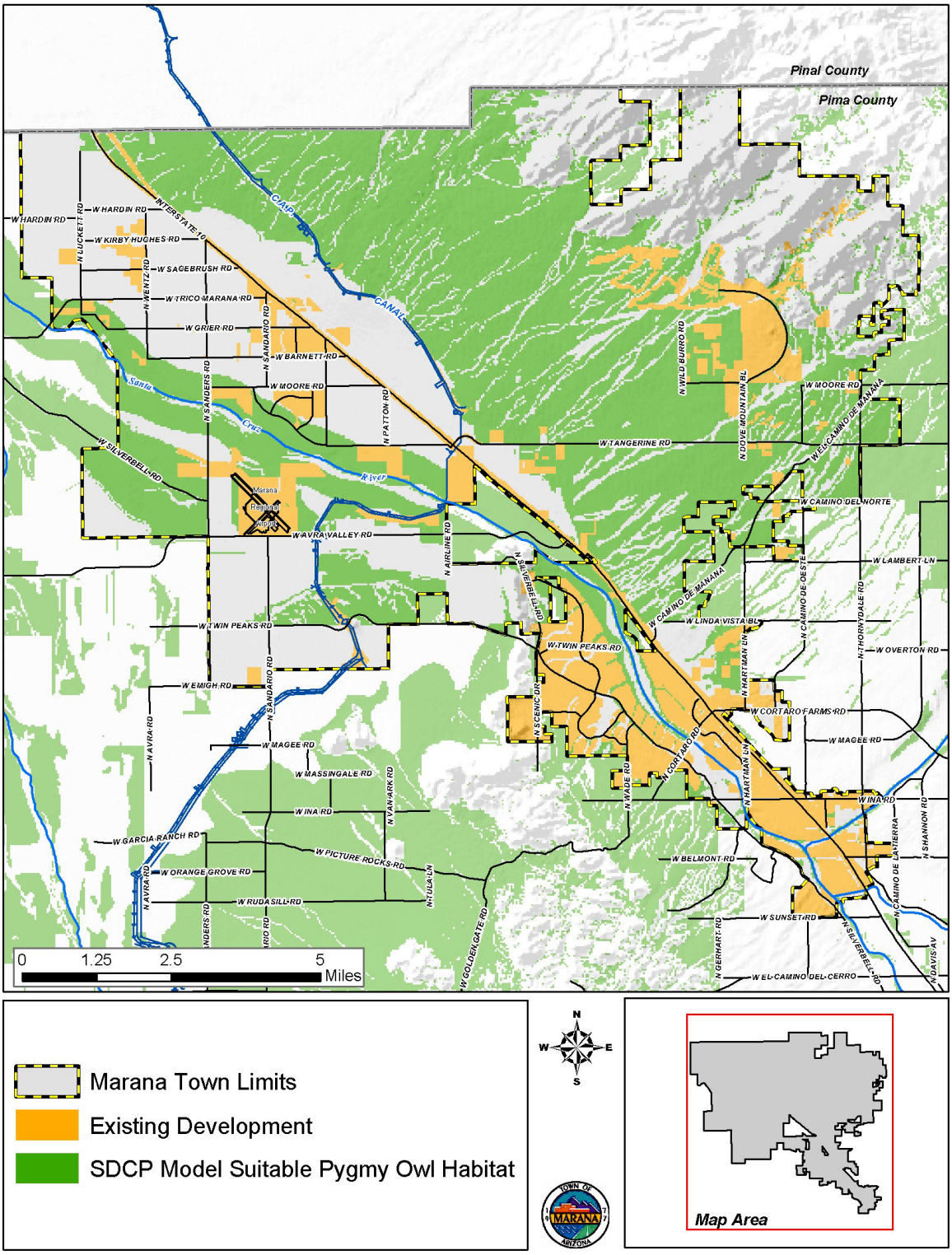

FIGURE 4.2-4
Sonoran Desert Conservation Plan Modeled Pygmy-Owl Potential Suitable Habitat in Marana.

Marana Conservation Plan CFPO Habitat Model

Potential impacts to CFPO can occur when there is disturbance to suitable habitat regardless of whether the habitat is designated critical habitat or recovery area. Thus, to ensure that the full extent of impacts is adequately addressed, the Town developed a habitat model specific to Marana to account for all potentially suitable habitat in the Town.

The SDCP model consisted of approximately 140 more acres of potential pygmy-owl habitat than did the draft recovery areas. The SDCP model, however, was based on generalized variables evaluated at a coarse scale and, therefore, resulted in an outcome that was not consistent with the current understanding of pygmy-owl habitat preferences. For example, the model indicated that wash corridors through the Tortolita fan were of low suitability when, in fact, these areas have some of the most suitable breeding and dispersal habitat. The draft recovery area includes the entire proposed critical habitat and is, therefore, the preferable of the two models. To this model was added additional areas of suitable habitat as identified by biologists with Arizona Game and Fish and the U.S. Fish and Wildlife Service. The Town of Marana CFPO habitat model consists of the 36,960-acre portion of the recovery area within Town and another 179 acres of suitable habitat (Figure 4.2-5). The majority of the recovery area within Marana (33,834 acres) falls on the east side of I-10.

Relation to Species' Range and Ecology

Much of the northeast portion of the Town is in Unit 3 of proposed critical habitat for the owl. This unit is thought to include the most contiguous and highest-quality CFPO habitat in Arizona. This unit has had one of the highest known densities of owls in Arizona, and is one of only four areas in the State with documented breeding CFPOs (USFWS 2002a). Marana also falls within Recovery Area 3 as identified in the draft CFPO Recovery Plan. This RA has accounted for 35 percent of the known CFPOs in Arizona and 40 percent of the known nests. The primary purposes of this area are to provide and protect breeding habitat for known CFPOs and for the establishment of new breeding pairs. RA 3 also is designed to allow movement of owls southwest to RA 2 and north to RA 4. RA 3 is regarded as essential to the survival and recovery of the overall CFPO population in Arizona (USFWS 2003a). Included in RA 3 are the Tortolita Fan and Northwest Tucson Special Management Areas (SMAs). The NW Tucson SMA is deemed especially important for maintaining habitat and movement corridors (USFWS 2003a).

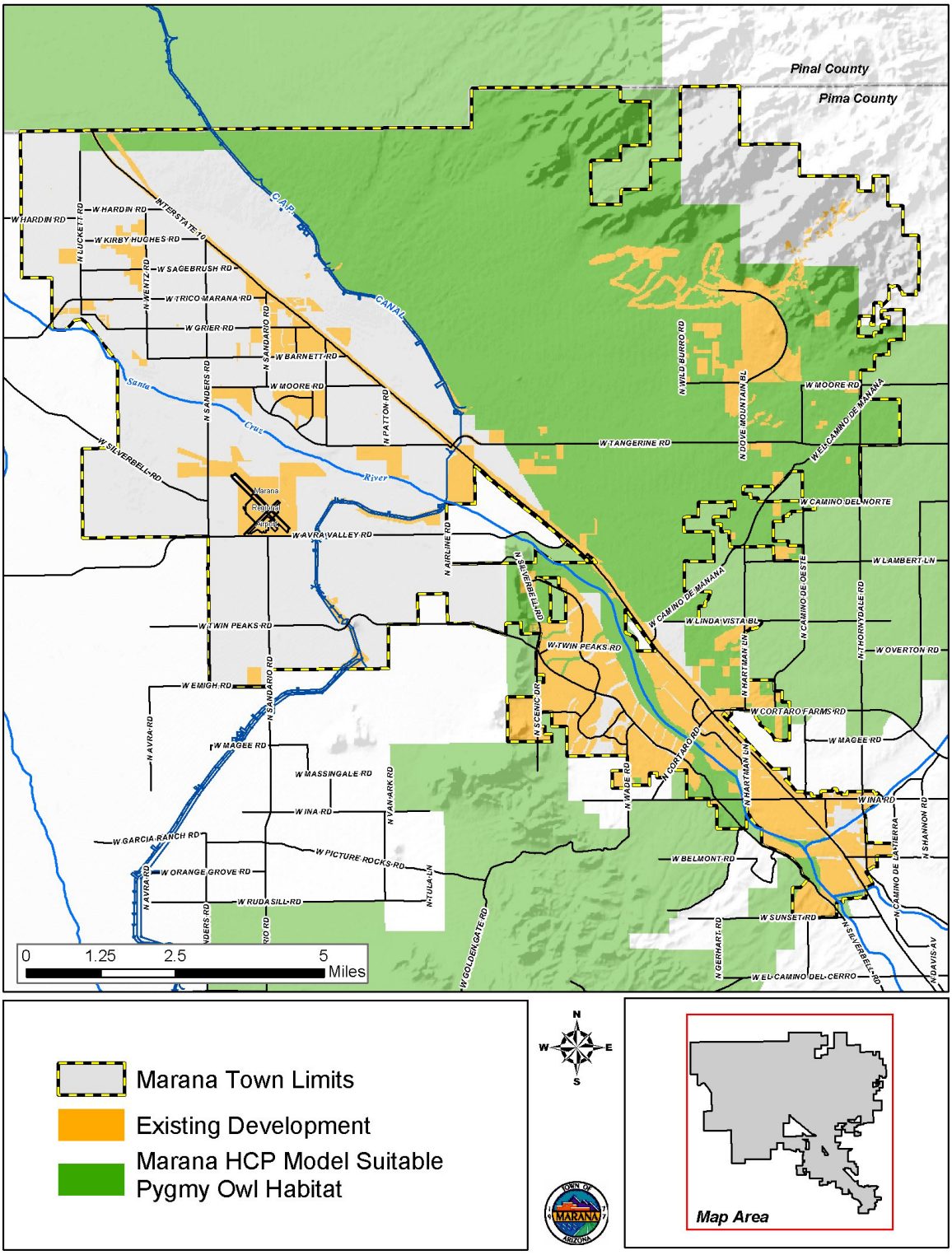

FIGURE 4.2-5
Town of Marana Revised Pygmy-Owl Potential Suitable Habitat in Marana.

4.2.3 Potential Impacts of Town's Proposed Activities

Direct Effects

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

As of the end of the 2004 CFPO breeding season, there were no known active nest sites within the planning area, so there is currently a minor risk of nest abandonment or mortality of juveniles associated with the covered activities. However, over the life of the Permit, the status of the pygmy-owl could change and alter the potential for these effects to occur. There are currently three known active territories occupied by unpaired adult male owls, and these owls could be affected by the proposed activities. It is unlikely that an owl would be directly killed as a result of the covered activities; but, since there are only three known owls within the planning area, direct take of any one would be a significant impact to the species.

Indirect Effects

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

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

Changes in Habitat

Based on discussions with USFWS, for the purposes of the analysis of impacts on pygmy-owls in this HCP, the Marana Conservation Plan Habitat Model (a modified version of the recovery areas) is used to define potential suitable habitat within Marana. However, impacts to proposed critical habitat also are considered. The bulk of the CFPO habitat in Marana occurs on the east side of Interstate-10. Due to the vast difference in acreage and the differences in development threats between east and west-side habitat, effects to CFPO from development in these two areas are discussed separately.

Impacts to Suitable Pygmy-Owl Habitat in Eastern Marana

Planned residential and commercial development and capital improvement projects would directly impact 23,861 acres of suitable habitat in eastern Marana (Figure 4.2-6 and 4.2-7). Of this acreage, 6,185 acres of habitat would be impacted by high intensity development and 17,676 acres would be in low intensity development. Low intensity development is defined as that which has a maximum disturbance of 30 percent of less or a housing density of one RAC or less. Areas of low intensity development are currently believed to be suitable for CFPO sheltering, feeding, and movement/dispersal even after development and many of these areas also have the potential to support nesting pairs. Owls have rarely been observed using areas of high human activity and high -intensity development is considered to render habitat unsuitable for pygmy-owls. Under full build-out, 8,452 acres of undisturbed CFPO habitat would remain in the Town, outside of any habitat remaining in low-density developments (Table 4.2-2).

Impacts to Suitable Pygmy-Owl Habitat in Western Marana

Planned residential and commercial development and capital improvement projects would directly impact 609 acres of suitable habitat in western Marana (Figure 4.2-7). Of this acreage, 496 acres of habitat would be impacted by high intensity development and 113 acres would be in low intensity development. Under full build-out, 1,507 acres of undisturbed CFPO habitat would remain on the west side of Town, outside of any habitat remaining in low-density developments (Table 4.2-3).

TABLE 4.2-2
Existing acreage of pygmy-owl habitat and projected future acreage of pygmy-owl habitat in the Town east of Interstate-10

	Critical Habitat	Suitable Habitat[1]
Existing Acreage	**20,781**	**32,313**
Low intensity development	5,603	6,112
High intensity development	9,128	17,676
Roads	65	73
Total Impact	**14,796**	**23,861**
Total Unimpacted	**5,985**	**8,452**

[1] Marana Conservation Plan CFPO Habitat Model

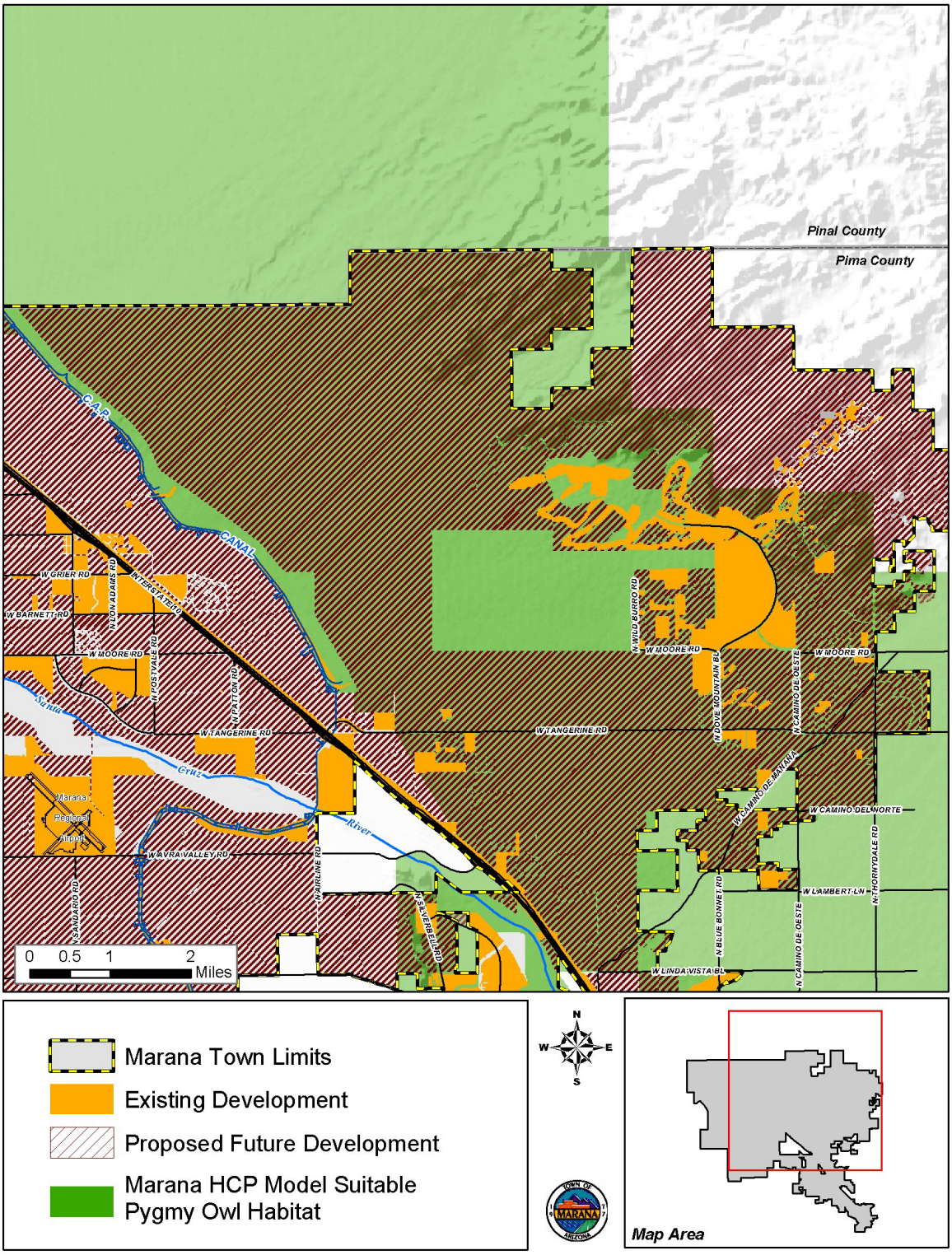

FIGURE 4.2-6
Future Development within Potential Suitable Pygmy-Owl Habitat in North and Eastern Marana

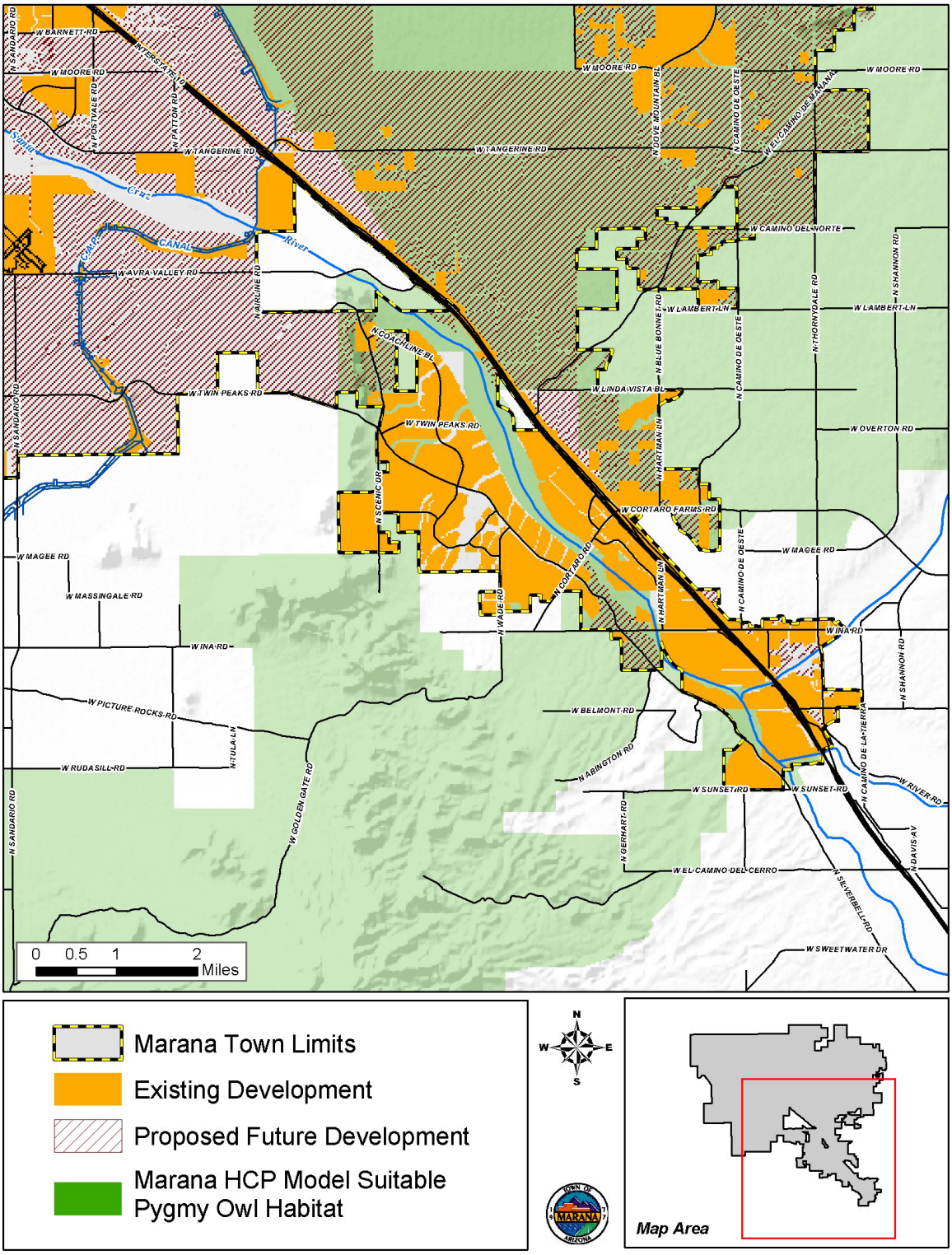

FIGURE 4.2-7
Future Development within Potential Suitable Pygmy-Owl Habitat in South Marana.

TABLE 4.2-3
Existing acreage of pygmy-owl habitat and projected future acreage of pygmy-owl habitat in the Town west of Interstate-10

	Critical Habitat	Suitable Habitat[1]
Existing Acreage	**2,116**	**2,592**
Low intensity development	113	113
High intensity development	431	431
Roads	65	67
Total Impact	**609**	**611**
Total Unimpacted	**1,507**	**1,981**

[1] Marana Conservation Plan CFPO Habitat Model

Impacts to Proposed Pygmy-Owl Critical Habitat in Eastern Marana

Planned residential and commercial development and capital improvement projects would directly impact 14,796 acres of proposed critical habitat. Of this acreage, 5,668 acres of critical habitat would be impacted by high intensity development and 9,128 acres would be in low intensity development. Under full build-out, 5,985 acres of undisturbed CFPO critical habitat would remain in the Town, outside of any habitat remaining in low-density developments (Table 4.2-2).

Impacts to Proposed Pygmy-Owl Critical Habitat in Western Marana

Planned residential and commercial development and capital improvement projects would directly impact 611 acres of proposed critical habitat. Of this acreage, 498 acres of critical habitat would be impacted by high intensity development and 113 acres would be in low intensity development. Under full build-out, 1,981 acres of undisturbed CFPO Critical habitat would remain in the Town, outside of any habitat remaining in low-density developments (Table 4.2-3).

Large-Scale Impacts to Proposed Pygmy-Owl Critical Habitat

Marana covers the central portion of critical habitat Unit 3. This unit contains a total of 73,958 acres, less than one-third of which (20,562 acres) falls within the Town. The northern portion of Unit 3 connects to Units 2 and 4, providing movement corridors for owls. A total of 12,701 acres (17%) of Unit 3 occurs southeast of the Town but is connected to other areas of critical habitat only through that portion of critical habitat within Marana and could potentially be isolated if a large amount of the habitat within the Town is disturbed. The habitat to the southeast of Marana occurs in a rapidly developing area. At present, approximately 45 percent (5,926 acres) has already been developed and only 6,749 acres remain undisturbed. Future development within Marana has the potential to isolate these 6,749 acres of critical habitat (Unit 3).

The Town also is located on the northeast boundary of critical habitat Unit 2. Unit 2 connects to Unit 3 in two places: (1) north of Marana in Pinal County and (2) three narrow strips running through southern Marana. Future development in Marana will not

significantly impact the northern (Pinal County) corridor, but could have some affect on the southern corridor. The southern corridor connects critical habitat Unit 3 (on the east side of I-10) to habitat in Saguaro National Park west (on the west side of the Interstate). There are 8,802 acres of critical habitat in Unit 2 between the boundary of Units 2 and 3 and the Saguaro National Park (3,191 acres in Marana and 5,611 acres in unincorporated Pima County). Of this area, nearly a third of the critical habitat within the Town, and more than half of the critical habitat in unincorporated Pima County, is currently developed. The remaining 55 percent (4,965 acres) of critical habitat in this area is largely in small, isolated fragments. Of the 2,116 acres of critical habitat in Marana that are not currently developed, two-thirds (1,507 acres) is located in the Santa Cruz River floodplain. Outside of the floodway, only 609 acres of currently undeveloped, critical habitat occurs on the west side of I-10 in Marana; although 113 acres are proposed for low intensity development, which is consistent with the habitat preferences of the owl as currently understood. If a large portion of the remaining habitat (496 acres) is developed, however, the corridor between habitat in eastern Marana and habitat west of Marana could be compromised.

In total, there are 1,208,001 acres of critical habitat proposed for the CFPO. All of this acreage is in Arizona, with approximately 88 percent (1,070,551 acres) in Pima County and the remaining 12 percent (137,450 acres) in Pinal County. Urban development in Marana would impact approximately 15,447 acres of critical habitat (64% of critical habitat within Marana, 1.4% of critical habitat within Pima County) plus an additional 9,170 acres of potentially suitable habitat outside of critical habitat.

Population Effects

The planning area is subject to ongoing residential and commercial development pressures, capital improvements, and state, local, and private actions. Many individual parcels do not have a federal nexus and, as they are developed, will not have to go through section 7 consultations. These planned residential and commercial developments, schools, and churches in the planning area likely will further reduce and fragment CFPO habitat. These activities continue to reduce the amount of habitat and reduce possible movement corridors in the planning area. Within Marana, the proposed covered activities would contribute to an overall loss of CFPO habitat (approximately 15,447 acres) and could lead to further fragmentation and adverse effects on movement corridors. Most of this development (72 percent), however, is slated to be low intensity (one acre or more per home), a level of development that is currently considered to be consistent with preserving the life history needs of the pygmy-owl.

It is unlikely that there would be a direct loss of an owl due to implementation of covered activities. However, approximately 1.4 percent of statewide critical habitat, and a total of 24,617 acres of suitable habitat, would be lost or indirectly impacted in Marana, which could reduce the maximum number of breeding pairs that could be sustained within Arizona.

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

Much of the remaining critical habitat within Marana that is immediately adjacent to and northeast of Interstate-10 and immediately southwest of Interstate-10 is planned for development within the next 20 years. If this development occurs in a manner that is not conducive to owl occupancy and movement, the linkage between habitat in Marana and that to the southwest could be greatly impaired. The actual impact of these proposed covered activities will be dependent on the ability of CFPOs to use of this corridor, which would require them to pass through extensive areas of development and cross a six lane, divided highway. There is no evidence that CFPOs are currently using this corridor between the western (Saguaro National Park and south) and eastern (Tortolita fan) portions of critical habitat; however no data suggests that this corridor is not or could not be used by CFPOs.

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

4.2.4 Biological Goals and Objectives

As noted above, there are only three known, active pygmy-owl territories in or near the Town, and all three territories are occupied by males. Much of the Town east of Interstate-10, also has been proposed for designation as critical habitat for the CFPO. There continues to be uncertainty with regard to the level of disturbance that can be supported in pygmy-owl habitat without impairing the ability of that habitat to support pygmy-owls over the long term. Based on this information, the Town's biological goals and objectives for pygmy-owls relate to ensuring that development activities within the Town do not lead to the permanent loss of pygmy-owls from the Town and to maintaining sufficient habitat within the Town to support significantly more owls than are currently present. Specifically, the Town's biological goal for CFPOs is to

- Contribute to maintaining local and regional populations of CFPOs.

The Town's specific objectives are to

- Increase the number of breeding pairs of pygmy-owls in the Town and support breeding pairs and breeding/year-round habitat in the Town, and
- Maintain habitat connectivity in critical movement corridors for pygmy-owls.

4.2.5 Conservation Measures

There are two possible conservation strategies for achieving the goal and objectives outlined above. The first strategy is to maintain the integrity of habitat in and around all known owl territories currently in the Town, while ensuring that disturbance in areas not historically occupied by owls is permitted only at a level that allows the establishment of pygmy-owl territories if, in the future, the planning area owl population increases. This strategy proposes development standards for private landowners and municipalities in areas with existing development, available infrastructure, and higher demand for development.

Development standards have more flexibility in the relatively pristine areas of State Trust Land within the Town that do not have existing development and infrastructure. This approach focuses primarily on preserving all known owl territories and maintaining sufficient habitat for future expansion of the Marana pygmy-owl population. Efforts are focused on protecting the existing pygmy-owl population and adequate habitat in order for this population to contribute to overall CFPO recovery within the state. This strategy is consistent with the current approach taken during section 7 consultations within Marana and is, therefore, referred to as the Section 7-based Approach.

The second pygmy-owl conservation strategy focuses on preserving a large, contiguous block of the remaining area of undisturbed suitable habitat found on State Trust Land within the Town. Shifting the conservation focus to this area allows greater flexibility with regard to development in and around existing owl territories and, therefore, may allow some higher development densities on private lands on the urban interface in southeastern Marana. Due to the very low pygmy-owl population size in Arizona, however, the loss of any birds would be significant. The only way this shift in focus can succeed is if the Town's population of pygmy-owls is augmented thereby reducing the dependence of recovery on existing owls. In this manner there is a net gain in the local pygmy-owl population sufficient to ensure the long-term persistence of these owls. This strategy is called the Augmentation Approach. Each of the two alternative pygmy-owl strategies is discussed below.

4.2.6 Strategy A – Section 7-based Approach

Through implementation of the section 7-based pygmy-owl conservation program the Town seeks to make a positive and long-term contribution to the conservation of pygmy-owls. The Town's conservation strategy for pygmy-owls consists of actions to

- provide for the long term availability of breeding/year-round and dispersal habitat,
- avoid, minimize, or mitigate adverse impacts from urban development , and
- promote integrated, regional conservation planning for pygmy-owls.

The specific conservation measures that the Town will implement are detailed below. A monitoring and adaptive management program described following the conservation measures) complements these the conservation measures.

Pygmy-Owl Measure – A1. *The Town will, by ordinance or some other appropriate and legally binding mechanism:*

- *Limit surface disturbance within developments to 60%. The area addressed by this measure will consist of all lands with the Town that are north of Cortaro Road, south of the Pima/Pinal County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of the Town's eastern boundary (Figure 4.2-8).*

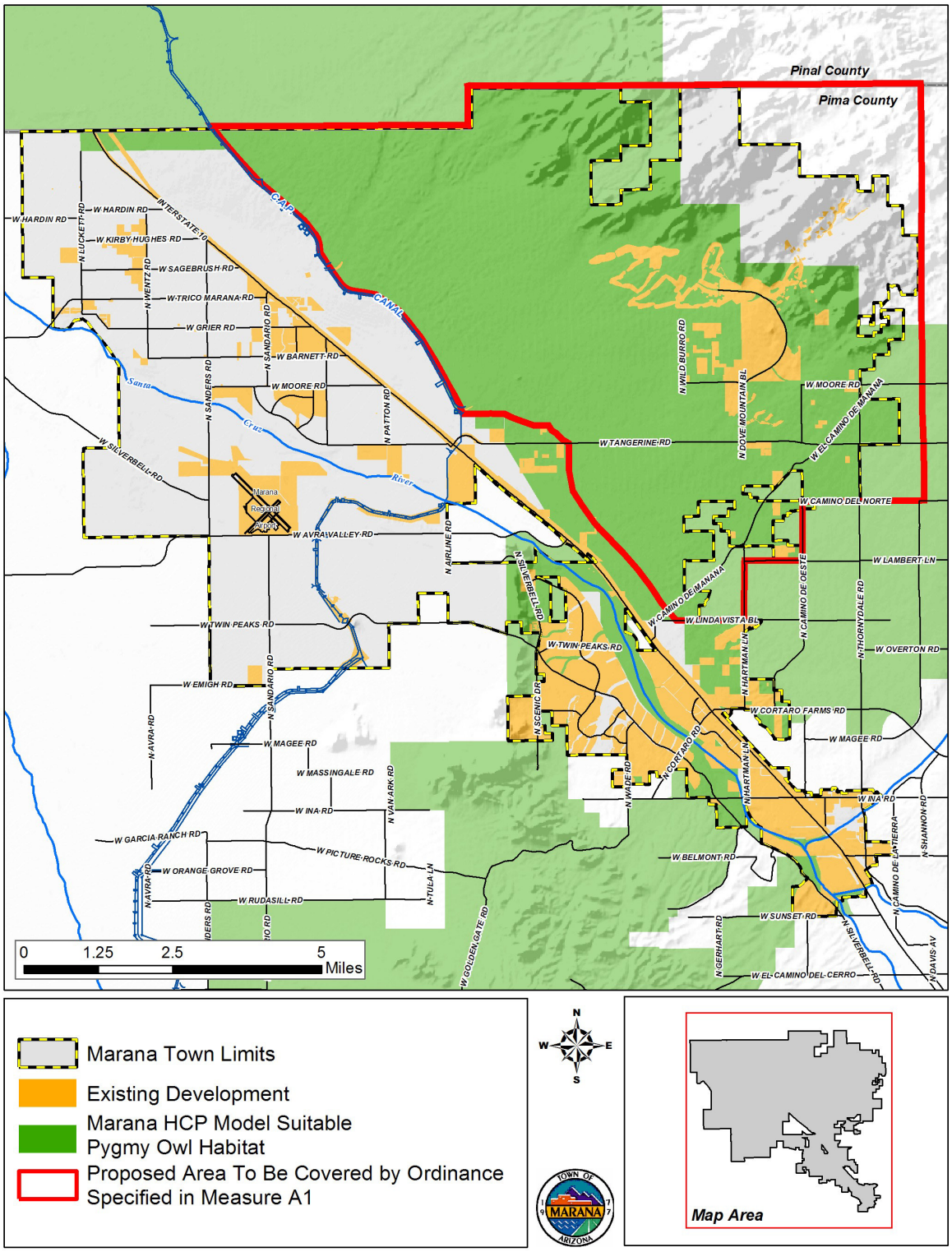

FIGURE 4.2-8
Proposed Boundary for Area Covered by Measure A1.

- *Require that developments avoid or minimize disturbance impacts to washes and wetlands, protected desert vegetation, rock outcroppings, and other significant natural features*
- *Require that continuity of natural undisturbed open space be maintained within and among developments and be located in a manner that preserves wildlife access and movement within and through the site, consistent with adjacent efforts to do the same.*
- *Prohibit the use of non-native and invasive plant species as landscaping*

The Town will obtain written approval from the USFWS on the final boundaries of the area to be covered by this measure.

Pygmy-Owl Measure – A2. *The Town will establish, by ordinance or some other appropriate and legally binding mechanism, three pygmy-owl conservation zones within the Town boundaries (Figure 4.2-9). Development standards will vary by zone as follows.*

- *Zone 1 will consist of those areas where there is some level of existing development and where pygmy-owls have primarily been located, historically. In this zone, surface disturbance limits established in Measure A1 will be superceded and disturbance will be restricted to no more than 20% to 30%. All other elements of Measure A1 will apply to properties in this zone.*
- *Zone 2 will consist of all areas that fall within the area covered by Measure A1, but are outside of Zone 1. Based on the lack of existing development in Zone 2, and based on the average level of disturbance in unincorporated Pima County in and around recent pygmy-owl territories in northwest Tucson, disturbance in this zone will be limited to no more than 40%. Within this zone, all other development standards in Measure A1 will apply, with the exception of the limit on surface disturbance which is superceded by Measure A2.*

  Using development incentives, such as increased net surface disturbance in lower value habitats for pygmy-owls, the Town will encourage land uses that result in substantially lower levels of surface disturbance within the Tortolita Fan SMA boundaries identified in the public draft of the CFPO Recovery Plan published by USFWS (Figure 4.2-3). These development incentives can permit an increase in disturbance levels up to 60%, given USFWS approval of the location of disturbance and the configuration of the undisturbed portion of the property.
- *Zone 3 will consist of all lands within Marana that are outside the area covered by Measure A1. In this zone, there will be no limit on surface disturbance, per se, however, proposed developments must leave undisturbed corridors through the property that are adequate to allow for dispersal of pygmy-owls.*

  Corridors will be preserved according to the following guidelines:

  – *All washes with a 100-year discharge greater than 500 cubic feet per second (cfs) will be protected with a 300-foot buffer.*

  – *The total buffer area will not exceed 30% of the area of the property, except that a minimum of one wash per property will be buffered.*

  – *If the minimum corridor protection of one wash with a 300-foot buffer would result in the inability for a parcel to be developed with a single home, the buffer may be reduced and*

modified such that a home can be built on the property. The modified wash corridor must, however, include the limits of the Army Corps of Engineers jurisdictional waters.

The Town may allow a developer to exceed the 20-30% and 40% disturbance limits specified in Measure 2 for Zones 1 and 2, respectively, as long as disturbance does not exceed the 60% limit established in Measure 1. Under specified circumstances this will be allowable, provided the impact is sufficiently addressed through a combination of on-site and off-site mitigation or approved mitigation fee. Acquisition of off-site mitigation will be required so that the total disturbance percentage between the development property and the off-site mitigation does not exceed the limits for the zone within which the development property occurs. Mitigation fees will only be accepted if there is an approved pygmy-owl mitigation bank or other appropriate acquisition program in place. This combination of on-site and off-site mitigation or mitigation fee will only be allowed if the development

- *is more than 600 meters from an active or formerly active CFPO territory center,*
- *does not block or otherwise interfere with dispersal to or from the territory center, and*
- *is not in conflict with the other goals and objectives of the HCP.*

In addition, off-site mitigation lands that are within 600 meters of an active or formerly active CFPO territory shall receive 2 for 1 credit as an offset for development activities, provided the authorized development meets the criteria described above.

The Town will obtain written approval from the USFWS on the final boundaries of the three pygmy-owl management zones. Developers will obtain written approval on any project that requires off-site mitigation regarding the total disturbance allowable on the development, the configuration of that disturbance, and the location and size of off-site mitigation lands.

Pygmy-Owl Measure – A3. *The Town will require that all development plans submitted to the Town for review and approval contain a narrative discussion documenting compliance with the conservation measures outlined and approved in the final HCP. This statement shall include maps and other graphics and analyses necessary to document this compliance. The submittal shall outline monitoring programs to document compliance with applicable grading limitations and the conservation measures approved in the HCP. This documentation also will include a drainage report that demonstrates that the proposed development will not significantly degrade the hydrologic regime of the property and includes an evaluation of the habitat impacts associated with the proposed drainage modifications.*

Pygmy-Owl Measure – A4. *The Town will require project proponents to establish and maintain a conservation easement (preferred) or restrictive covenant on all natural undisturbed open space (NUOS), to be held by an approved third party or the Town of Marana, or with third party rights of enforcement. This easement or deed restriction will be recorded prior to initiation of construction.*

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

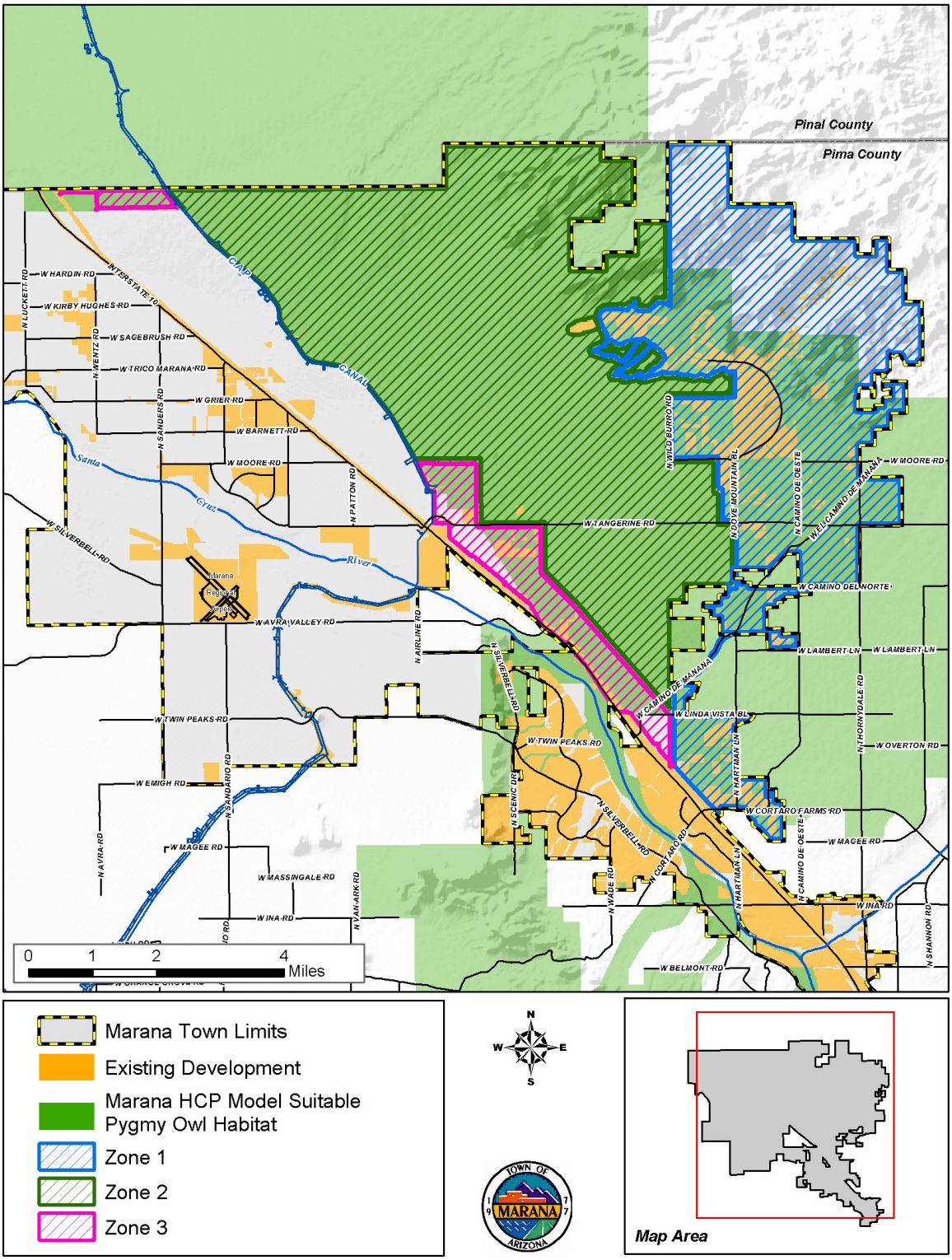

FIGURE 4.2-9
Proposed Development Restriction Zones.

- *NUOS will be maintained in a natural condition, except as approved by USFWS. A management plan must be submitted to and approved by the USFWS within 6 months of the initiation of construction activities*
- *Prior to occupancy of a residential lot, the disturbance limits of the lot shall be enclosed. If the disturbance limits represent only a portion of a larger lot, the property line of that lot may not be fenced.*
- *Lot owners will be required to contain all domestic animals within the enclosed lot or under strict control at all times. Pets that are outside of enclosed areas shall be leashed in conformance with Pima County Code 6.04.030.*
- *The NUOS will be surveyed by a professional biologist at least once every three years and a permitted biologist will conduct pygmy-owl surveys according to USFWS protocol (3 visits/year) until all construction activities within the development are completed.*
- *Native plants will be salvaged and replanted from any authorized disturbances, as approved by USFWS, which occur within the NUOS.*
- *No development or other activities are permitted in the NUOS except for approved pedestrian trails, developed in a manner that will avoid and minimize disturbance and removal of vegetation, and minor utility crossings (these will be revegetated).*
- *Reasonable measures will be utilized to control any invasive exotic species.*
- *Landscape and plantings outside of developed common areas and the enclosed area of individual lots will be restricted to native, drought-tolerant plants. Planting of non-native, invasive species is prohibited. A list of prohibited plants can be found in Appendix A.*
- *The following activities are prohibited within the NUOS: (a) use of firearms, (b) any off-road vehicle use, (c) use of pesticides or herbicides for purposes other than controlling invasion of exotic species, and (d) racing events or other publicized events that attract large crowds, (e) the use of fires or barbeques.*

Pygmy-Owl Measure – A5. *Public infrastructure improvements within Areas 1, 2, and 3 must be designed according to Pima County's environmentally-sensitive road design guidelines (Appendix B) or a similar standard. Any alternative design guidelines will be approved by USFWS.*

Pygmy-Owl Measure – A6. *Utilities not a part of development or road projects will be required to revegetate any disturbance, except for any necessary and approved access easements, with the same type of mix of species removed. Any suitable saguaros or large trees will be transplanted back onto the site. Grading and revegetation plans, showing both existing and replacement plant types, numbers, and relative sizes/volumes must be approved by USWFS prior to disturbance. The Town will encourage project proponents to construct utilities outside of the breeding season. If construction is done outside of the breeding season, pygmy-owl surveys (see section on Monitoring and Adaptive Management) will not be required, otherwise projects must follow the same survey protocol as for developments.*

4.2.7 Section 7-based Approach Monitoring and Adaptive Management

The Service's Five Points Policy specifies that HCPs should include monitoring and adaptive management. Typically, HCPs contain two types of monitoring.

1. *Compliance monitoring* – Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.
2. *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring for the Section 7-based Approach.

Compliance Monitoring and Reporting

Compliance monitoring and reporting will be accomplished through submittal of annual reports documenting progress toward and completion of the conservation commitments.

1. The Town will submit an annual report to the USFWS that includes the following information
    - Activities permitted by the Town in areas that contain suitable habitat for pygmy-owls, including location and acreage of the project.
    - Activities conducted by the Town in suitable pygmy-owl habitat
2. The Town will require each developer, HOA, or approved third party to submit an annual report to the USFWS that includes the following information
    a. Pre-construction report (within 60 days prior to construction):
    - Results of pygmy-owl surveys
    - Number of acres of development permitted for the project
    - Maps showing the configuration of disturbance and remaining open space
    - Anticipated timing of ground disturbance activities

    b. Construction-period report (within 30 days of completion):

    - Results of pygmy-owl surveys
    - Number of acres of surface disturbance that occurred during the previous year
    - Any violations of natural undisturbed open space on the property (e.g., accidental grading within the NUOS) and steps taken to address the violation

    c. Post-construction report (annual):

    - Any violations of natural undisturbed open space on the property (e.g., off-road vehicle impacts) and steps taken to address the violation

3. The Town will ensure that each developer or HOA submits to the USFWS copies of documentation securing the long-term conservation of mitigation lands.
4. The Town will ensure that each developer or HOA provides copies of pygmy-owl mitigation land management plans to the USFWS.

Effectiveness Monitoring and Reporting

Under a Section 7-based Approach, the effectiveness of the conservation program is measured in terms of (a) a lack of CFPO mortality, direct or indirect, as a result of permitted activities within the planning area and (b) the amount, configuration, and quality of habitat remaining within the planning area. Effectiveness monitoring, then, relates to ensuring that no owls are harmed, harassed, or killed as a result of permitted activities and can carry out all necessary life history requirements. The preservation of adequate habitat is addressed through the compliance reports and the requirement for USFWS approval of the location and configuration of mitigation lands.

Annuals Surveys of Pygmy-Owl Habitat

Through plat notes, permit conditions, rezoning requirements, or other appropriate methods, projects determined to occur within suitable CFPO habitat, will conduct surveys for owls for two consecutive years prior to initiation of construction activities. Surveys will be conducted according to USFWS protocol. All areas of potentially suitable pygmy-owl habitat in and within 600 meters of the proposed project area will be surveyed. The surveys will include identifying and mapping suitable habitat for pygmy-owls if habitat was not mapped as part of the general biological surveys.

Vegetation clearing and other significant construction activities must be completed by the end of the second year of surveys to minimize the potential for disturbance to pygmy-owls. If clearing extends beyond a single year, annual surveys will be conducted until construction is completed. No clearing activities are permitted during the breeding season (February 1 to July 31) without agreement from USFWS. If pygmy-owls are found on or adjacent to proposed project area, USFWS will be contacted and the following guidelines implemented

- Within 0 to 100 meters of the pygmy-owl activity center, no additional clearing will be permitted without agreement from USFWS. Construction activities may continue on lands that are already cleared of vegetation provided the level/intensity of activity do not exceed that occurring during the time the pygmy-owl territory was established. Construction activities with a greater level/intensity than those occurring during the time the territory was established cannot proceed without coordination with USFWS.
- Within 100 to 400 meters of the pygmy-owl activity center, no additional clearing will be permitted without agreement from USFWS. Construction activities, excluding vegetation clearing, may continue from August 1st through February 28th of the following calendar year without restriction. Between February 1st and July 31st (pygmy-owl breeding season) construction activities cannot exceed the level/intensity of those occurring during the time the territory was established and cannot proceed without coordination with USFWS.

- Within 400 to 600 meters of the pygmy-owl activity center, no additional clearing will be permitted without agreement from USFWS. Construction activities, excluding vegetation clearing, may continue during any time of the year without restriction.
- There are no restrictions on clearing or construction activities occurring greater than 600 meters from the pygmy-owl activity center.
- The project proponent will employ an onsite monitor to ensure compliance with the requirements of the HCP.
- The project proponent will avoid clustering the development in a manner that restricts pygmy-owl movement from the territory center to other suitable habitat areas.

Reporting

Survey results will be included in the annual report submitted by the developer or HOA to USFWS.

Effectiveness Assessment and Adaptive Management Program

The Effectiveness Assessment and Adaptive management program uses results from the surveys associated with development activities and the results of any survey efforts by Arizona Game and Fish Department or other entities to assess progress toward achieving the biological goals and objectives of the Pygmy-Owl Conservation Strategy. In addition, banding, nest monitoring, and telemetry, of known owls in HCP area will be funded by the Town, at a level that is commensurate with the impact of the Town's covered activities, as specified in the approved HCP and Permit. The following proposes criteria for determining the success of the strategy and actions to be undertaken if the success criteria are not met

Benchmark 1: *The pygmy-owl conservation strategy will be considered successful if:*

- *the number of occupied territories has increased annually for x[1] consecutive years*

The survey results will be reviewed on an annual basis and in any year this success criterion is not met (i.e., there are fewer than 3 occupied territories), then the Town will meet with the USFWS and any other appropriate pygmy-owl experts to review the information from surveys and any other relevant information (e.g., regional information on the status, distribution and trends in pygmy-owls) and recommend adjustments in implementation of the conservation strategy to improve the likelihood of meeting the success criteria. Management adjustments that would be implemented may include activities such as vegetation management or predator management in conservation easements of existing developments, but will not include an additional commitment of land or water. The Town also may integrate adjustments in how the measures are implemented for future developments. The adjustments, which would not apply to approved developments, could include limiting disturbance to the minimum provided for be the measures, HOA requirements and/or trying different development configurations. Success will be determined in light of natural conditions. If drought, old age, or other factors outside of the Town's control are affecting the achievement of the benchmarks, these factors will not result in alternatives in proposed covered activities or significant adjustments to management actions. One method for determining the role of natural conditions in changes in pygmy-

[1] Actual benchmarks will be determined through further discussions with USFWS.

owl numbers or activities in Marana would be to use other populations within the state as a comparison. Five-year reviews with management recommendations will continue until achievement of Benchmark 1.

Benchmark 2: *The pygmy-owl conservation strategy will be considered successful if:*

- *the number of breeding pairs has increased annually for x[1] consecutive years*

If this success criterion is not met then every five years the Town will meet with the USFWS and any other appropriate pygmy-owl experts to review the information from surveys and any other relevant information (e.g., information on the status of a regional augmentation effort) and recommend management adjustments to improve the likelihood of meeting the success criterion. Management adjustments that would be implemented may include activities such as vegetation management or predator management in conservation easements of existing developments, but will not include an additional commitment of land or water. The Town also may integrate adjustments in how the measures are implemented for future developments. The adjustments, which would not apply to approved developments, could include limiting disturbance to the minimum provided for be the measures, HOA requirements and/or trying different development configurations. Success will be determined in light of natural conditions. If drought, old age, or other factors outside of the Town's control are affecting the achievement of the benchmarks, these factors will not result in alterations in proposed covered activities or significant adjustments to management actions. One method for determining the role of natural conditions in changes in pygmy-owl numbers or activities in Marana would be to use other populations within the state as a comparison.

Five-year reviews with management recommendations will continue until achievement of Benchmark 2.

Benchmark 3: *The pygmy-owl conservation strategy will be considered successful if:*

- *reproductive success, survival, and mortality rates are such that the population is increasing with a lambda (rate of population growth) is greater than 1.0 for x[1] years out of x[1] years.*

If this success criterion is not met then every five years the Town will meet with the USFWS and any other appropriate pygmy-owl experts to review the information from surveys and any other relevant information (e.g., information on the status of a regional augmentation effort) and recommend management adjustments to improve the likelihood of meeting the success criterion. Management adjustments that would be implemented may include activities such as vegetation management or predator management in conservation easements of existing developments, but will not include an additional commitment of land or water. The Town may also integrate adjustments in how the measures are implemented for future developments. The adjustments, which would not apply to approved developments, could include limiting disturbance to the minimum provided for be the measures, HOA requirements and/or trying different development configurations. Success will be determined in light of natural conditions. If drought, old age, or other factors outside of the Town's control are affecting the achievement of the benchmarks, t these factors will not result in alterations in proposed covered activities or significant adjustments to

[1] Actual benchmarks will be determined through further discussions with USFWS.

management actions. One method for determining the role of natural conditions in changes in pygmy-owl numbers or activities in Marana would be to use other populations within the state as a comparison. Five-year reviews with management recommendations will continue until achievement of Benchmark 3.

On-Going Monitoring and Adaptive Management

Following achievement of Benchmark 3, the Town will continue to meet with the USFWS and other pygmy-owl experts as appropriate every 5 years to verify continued achievement of the biological goals and objectives. If the annual surveys reveal that Benchmark 3 is no longer met, the Town, USFWS and other experts as appropriate will identify management adjustments to regain this benchmark.

4.2.8 Strategy B– Augmentation Approach

Through implementation of the Strategy B of the pygmy-owl conservation program the Town seeks to make a positive and long-term contribution to the conservation of pygmy-owls. This conservation strategy for pygmy-owls consists of actions to

- provide for the long term availability of breeding/year-round and dispersal habitat,
- facilitate the augmentation of the local pygmy-owl population,
- reduce adverse impacts from development and associated with urbanization, and
- promote integrated, regional conservation planning for pygmy-owls.

The specific conservation measures that the Town will implement are detailed below. A monitoring and adaptive management program described following the conservation measures) complements these the conservation measures.

Pygmy-Owl Measure – B1. *The Town will acquire State Trust Lands in the Tortolita fan to set aside as a permanent preserve with 16,200 acres of breeding/year-round and dispersal habitat (Tortolita Preserve). An additional 2,400 acres will be included in the preserve with the purchase of the current Tortolita Preserve leased by the Town in an agreement with Cottonwood Properties. The total area of the expanded Tortolita Preserve will be approximately 18,600 acres. The preserve will roughly consist of all State Trust Land beginning 3600 feet north of Tangerine Road, and from the CAP canal east to the Town boundary (Figure 4.2-10).*

The Town will have a period of 5 years to establish the preserve, through outright purchase, either alone or in cooperation with one or more other entities; lease; land exchange; or purchase of development rights. Within a year of acquisition, the Town or other management entity will prepare a management plan for all lands acquired as part of the pygmy-owl preserve. The Town will obtain written approval from the USFWS on the pygmy-owl preserve. The Town will develop a monitoring and management plan for the preserve and obtain approval on the plan from the USFWS.

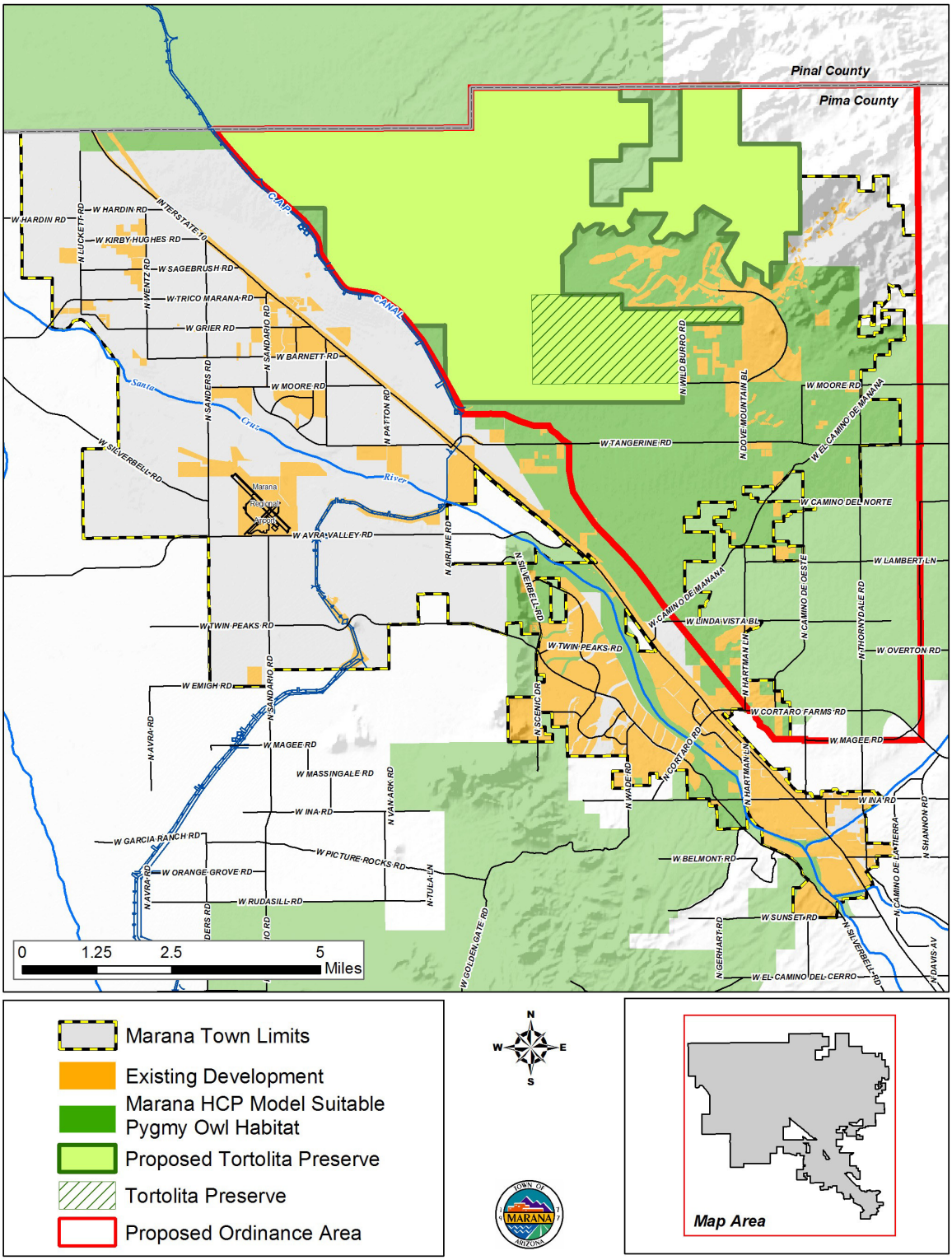

FIGURE 4.2-10
Proposed Tortolita Preserve Expansion and Pygmy-Owl Augmentation Location.

Pygmy-Owl Measure – B2. *The Town will facilitate the augmentation of the NW Tucson pygmy-owl population by supporting the release of owls within the preserve using an augmentation strategy approved by USFWS. The Town will provide a monetary contribution of $_____ to support a USFWS -implemented augmentation of the NW Tucson pygmy-owl population. The USFWS and AGFD will coordinate and arrange all other aspects of the augmentation effort, including the labor and equipment necessary to acquire and release the owls. The details of the augmentation strategy will be developed as the USFWS and AGFD move forward with a statewide, scientifically-based augmentation policy and will be consistent with this larger effort.*

The augmentation program will be implemented according to the following guidelines:

- *Once the preserve is established, an initial small-scale augmentation, on the order of 10-15 owls, will occur within one year. The augmentation program will commence within three years of the issuance of a permit, however, regardless of the status of the preserve.*
- *The scale and methods of successive augmentation efforts will be based on the information derived from initial efforts and availability of owls.*
- *If, according to the guidelines laid out in the adaptive management and monitoring component of this plan and the guidance provided by the state-wide augmentation program, the Marana augmentation effort is judged unsuccessful by USFWS, the augmentation program for the Tortolita Preserve may be discontinued for the remainder of the permit term, and alternative approaches developed.*

For lands outside the preserve but within the boundary covered by the HCP, including private and public lands in Marana and unincorporated Pima County, property owners will not be subject to Section 9 enforcement of non-lethal take of pygmy-owls resulting from otherwise lawful actions. The definition of these boundaries will be developed later and must be approved by USFWS. This boundary would generally be based on dispersal distances and available suitable habitat. Other jurisdictions, including unincorporated Pinal County, the Town of Oro Valley, and the City of Tucson may also receive similar take assurances upon approval of independent HCPs that incorporate similar elements as described in this conservation strategy. Impacts to suitable habitat from Interstate-10 east to Cienega Creek Preserve (Figure 4.2-11) can be addressed in this manner; although, the specific details would have to be described in an HCP and would be subject to USFWS approval.

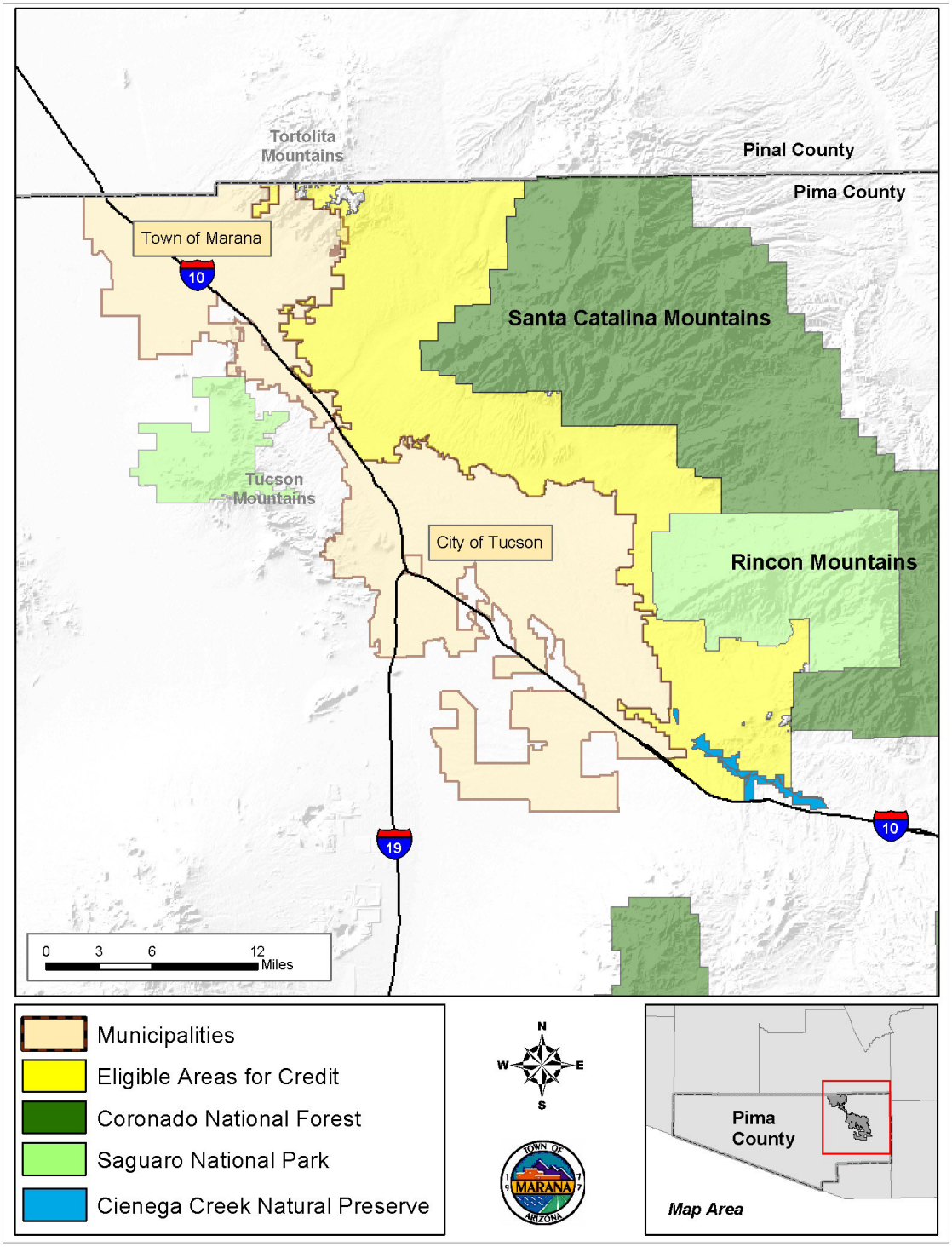

FIGURE 4.2-11
Area with Potential for Addressing Pygmy-Owl Impacts through Purchase of Mitigation Credits in the Tortolita Preserve Expansion.

Pygmy-Owl Measure – B3. *To address lands outside of the preserve, the Town will, by ordinance or some other appropriate and legally binding mechanism:*

- *Limit surface disturbance within developments to 60%. The area covered by this measure consists of all land with Marana that is north of Magee Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of a line corresponding to the Shannon Road alignment (Figure 4.2-8)*
- *Impose a variable environmental mitigation fee on development that exceeds 30% disturbance. The amount of this fee will be based on total disturbance permitted within the development and will be used to acquire preserve land and/or fund augmentation or management efforts associated with the preserve*
- *Maintain the integrity of washes, areas of sheet flow, and wetlands; minimize disturbance to protected desert vegetation, rock outcroppings, and other significant natural features*
- *Require that continuity of natural undisturbed open space be maintained within and between developments and be located in a manner that preserves wildlife access and movement within and through the site*
- *Prohibit the use of non-native invasive plant species as landscaping (see Appendix A for list)*

The Town will obtain written approval from the USFWS on the final boundaries of the area to be covered by Measure B3.

Pygmy-Owl Measure – B4. *The Town will preserve corridors between the preserve and habitat to the south of the preserve by requiring that development on the remaining State Land, within the Town and east of Interstate-10, provide for sufficient dispersal corridors for pygmy-owls across Tangerine Road and between areas currently occupied by owls and the preserve.*

These corridors will, at a minimum, consist of five 300-meter (984-foot) wide corridors centered on the 5 largest washes crossing Tangerine Road (Figure 4.2-12). The Tangerine Road crossings will be structured so as to allow movement of pygmy-owls across the road, based on Pima County's environmental-sensitive road design guidelines (Appendix B) or a similar standard.

Pygmy-Owl Measure – B5. *The Town will, by ordinance or other legally-binding measure, preserve dispersal corridors across Interstate-10 by establishing development guidelines for dispersal habitat that along the Interstate. Proposed developments will be required to leave undisturbed corridors through the property that are adequate to allow for dispersal of pygmy-owls. Corridors will be preserved according to the following guidelines:*

- *All washes with a 100-year discharge greater than 500 cubic feet per second (cfs) will be protected with a 300-meter (984-foot) wide buffer. The total buffer area will not exceed 30% of the area of the property, except that a minimum of one wash per property will be buffered.*
- *If the minimum corridor protection of one wash with a 30.5-meter (300-foot) wide buffer would result in the inability for a parcel to be developed with a single home, the buffer may be reduced and modified such that a home can be built on the property. The modified wash corridor must, however, include the Army Corps of Engineer jurisdictional wash area.*

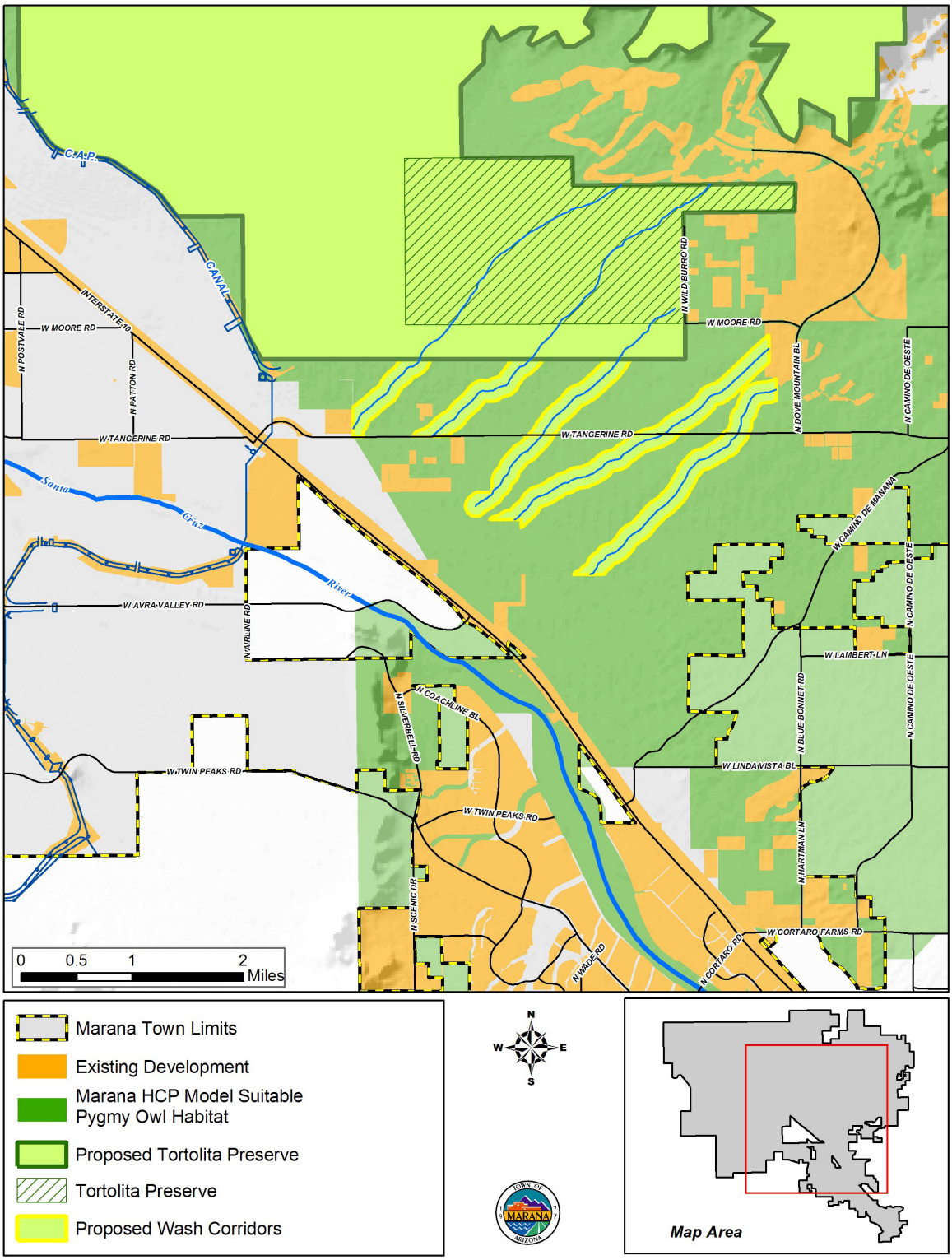

FIGURE 4.2-12.
Proposed Corridors Across Tangerine Road.

Pygmy-Owl Measure – B6. *Utilities not a part of development or road projects will be required to revegetate any disturbance, except for any necessary and approved access easements, with the same type of mix of species removed. Any suitable saguaros or large trees will be transplanted back onto the site. Grading and revegetation plans, showing both existing and replacement plant types, numbers, and relative sizes/volumes must be approved by USFWS prior to disturbance. The Town will encourage project proponents to construct utilities outside of the breeding season. If construction is done outside of the breeding season, pygmy-owl surveys (see section on Monitoring and Adaptive Management) will not be required; otherwise projects must follow the same survey protocol as for developments.*

Pygmy-Owl Measure – B7. *For developments west of Interstate-10, the Town will require project proponents to comply with the terms of Measure B3, including, but not limited to maximum disturbance limits, mitigation fees, configuration of undisturbed open space, and landscaping requirements.*

Pygmy-Owl Measure – B8. *In order to prevent lethal take of pygmy-owls, the Town will require project proponent to request and receive written confirmation from Arizona Game and Fish Department information on whether any pygmy-owls are located in the project area. If there is a pygmy-owl on the project site, the proponent will coordinate with USFWS to modify construction timing, development phasing, development configuration, or otherwise modify their project to avoid lethal take of the owls. At the point that the augmentation program is deemed successful by USFWS, restrictions on lethal take may be relaxed.*

4.2.9 Augmentation Approach Monitoring and Adaptive Management

The Service's Five Points Policy specifies that HCPs should include monitoring and adaptive management. Typically, HCPs contain two types of monitoring.

1. *Compliance monitoring* – Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.
2. *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring.

Compliance Monitoring and Reporting

Compliance monitoring and reporting will be accomplished through submittal of annual reports documenting progress toward and completion of the conservation commitments.

1. The Town will submit annual reports to the USFWS that includes the following information

- Status of land acquisition for preserve
- Activities permitted by the Town in areas that contain suitable habitat for pygmy-owls
- Amount of mitigation funds received by the Town for acquisition and management of the preserve and augmentation under the Measure B3
- Status of land acquired/preserved to serve as corridors identified under Pygmy-Owl Measure - B4 and compliance with approved management plan.

2. The Town will submit to the USFWS copies of documentation demonstrating the mechanism for long-term conservation of preserve lands and corridors.
3. The Town will provide copies of pygmy-owl preserve management plans to the USFWS.

Effectiveness Monitoring and Reporting

Annuals Surveys of Pygmy-Owl Preserve

Once the preserve is established and the augmentation effort and other management actions to establish birds have been implemented, the Town will provide funding for annual surveys of pygmy-owls and to assess habitat condition of suitable habitat within the HCP area to evaluate the success of augmentation efforts in the Town. This survey effort also will include nest monitoring, banding, of telemetry of known owls within the HCP area. The owl surveys and habitat assessment will be funded by the Town, at a level that is commensurate with the impact of the Town's covered activities, as specified in the approved HCP and take permit. The surveys will be conducted by the Arizona Game and Fish Department who also will be responsible for preparation of the annual reports and submission to the USFWS. Initially, all owls will need to be monitored; however, as the population grows, a subsample of the owls and the area of suitable habitat will be monitored/surveyed.

<u>Pygmy-Owl Surveys</u>

- Conduct call surveys during the breeding season to determine number of owls occupying the preserve, nesting status and reproductive success
- Band resident adults and young

<u>Population Assessment</u>

- Band all augmented and wild pygmy-owls
- Conduct nest monitoring to document reproductive success
- Conduct telemetry monitoring to assess survival and mortality of both resident and dispersing pygmy-owls.

<u>Habitat Assessment</u>

- Document vegetation conditions at each owl location, including plant species diversity, community structure, and canopy cover
- Document overall quality of the preserve

Reporting

- Submit annual report to USFWS of results of pygmy-owl surveys and habitat assessment

During pygmy-owl surveys, banding activities, and habitat assessments, field personnel will record observations of dead or injured pygmy-owls. Where possible, the cause of the mortality or injury will be documented through field notes and photographs. In addition, field personnel will record through field notes and/or photographs, observations or evidence of potential mortality sources for pygmy-owls in the Town. Known or suspected causes of mortality for pygmy-owls include, but are not limited to

- Predation by natural predators
- Predation by feral and domestic animals
- Collisions with cars, glass windows, fences, and power lines
- Exposure to agricultural pesticides
- Disease, such as Trichomoniasis or West Nile Virus

Field personnel will document through field notes and/or photographs, observations germane to these potential mortality sources.

Effectiveness Assessment and Adaptive Management Program

The Effectiveness Assessment and Adaptive management program uses results from the annual surveys of the preserve to assess progress toward achieving the biological goals and objectives of the Pygmy-Owl Conservation Strategy. The following are proposed criteria for determining the success of the preserve.[2]

- Owls have successfully established territories within the Town
- Breeding pairs have successfully established territories within the Town
- Pygmy-owls have successfully nested (i.e., produced at least one fledgling) in the Town
- Owls have dispersed outside the preserve and successfully established territories outside the preserve
- Population increasing with a lambda (rate of population growth) greater than 1.0 for x years out of x years.

If these success criteria are not met then, every five years, the Town will meet with the USFWS and other appropriate pygmy-owl experts to review the information from the annual surveys and any other relevant information (e.g., information generated through other survey efforts, Arizona Game and Fish Department research, or resulting from other HCPs or Section 7 consultations). Based on this review the Town, USFWS and others will identify management adjustments to improve the likelihood of meeting the success criteria. Management adjustments that the Town would implement may include activities such as installing nest boxes or stock tanks, vegetation management, or predator management but will not include an additional commitment of land, water, or significant monetary resources. Success will be determined in light of natural conditions. If drought, old age, or other factors

[2] These success criteria will likely be measured in rates or trends rather than hard numbers. They will likely include a time frame and recognize that it may be a while before it is known if augmentation is going to be successful. Actual benchmarks will be determined through further discussions with USFWS and will be consistent with any larger augmentation effort in Arizona.

outside of the Town's control are affecting the achievement of the benchmarks, these factors will not result in alterations in proposed covered activities or significant adjustments to management actions. One method for determining the role of natural conditions in changes in pygmy-owl numbers or activities in Marana would be to use other populations within the state as a comparison. Five-year reviews with management recommendations will continue until achievement of Benchmark 3.

If the established success criteria are not met, then the augmentation will be re-evaluated and, if appropriate, discontinued. The benchmarks, success criteria, and guidelines for modifying or discontinuing the augmentation effort will be developed in concert with the USWFS and consistent with any statewide augmentation program. If the augmentation program is unsuccessful, the Town will work with the USFWS to develop a contingency plan. Any commitment of money, land, water, or other resources as part of a contingency plan will be at a level that is commensurate with the impact of the Town's covered activities, as specified in the approved HCP and take permit.

On-Going Monitoring and Adaptive Management

Following achievement of all success criteria, the Town will continue to annually monitor pygmy-owls in eastern Marana. The Town will continue to meet with the USFWS and other pygmy-owl experts as appropriate every 5 years to verify continued achievement of the biological goals and objectives. If the annual surveys reveal that is the success criteria are no longer met, the Town, USFWS and other experts as appropriate will identify management adjustments to regain the established goals.

4.2.10 Effects of Implementing the HCP on Pygmy-Owls

Two conservation strategies have been proposed in the HCP for pygmy-owl conservation. The impacts of these strategies will be discussed separately.

Strategy A – Section 7-based Approach

Proposed future development in the Town is predicted to directly impact about 16,529 acres of potential habitat for pygmy-owls in the Town. Approximately 18,376 acres of potential habitat would not be impacted by anticipated development. Although there appears to be a considerable amount of suitable habitat in the Town (about 34,905 acres), only three owls are known to currently inhabit the Town. The Town's conservation approach to pygmy-owls is to maintain a sufficient amount and configuration of breeding and dispersal habitat in an effort to maintain owls in the Town and to allow future owls to establish territories within the Town.

Under the Strategy A of the HCP, the Town would minimize disturbance to suitable habitat within the Town by requiring that development within Marana to comply with limits on maximum allowed disturbance, with these limits determined based on the location of the development relative to existing disturbance and known pygmy-owl locations. The limits are based on USFWS's and AGFD's best understanding of what level of disturbance pygmy-owls seem to tolerate and that will not render the adjacent habitat unsuitable for long-term persistence of the owl. Three zones have been identified within the Town that establish areas subject to some level of restriction on surface disturbance. The three zones will provide the following amounts of habitat within the Town.

- In Zone 1, surface disturbance will be limited to 20 to 30 percent maximum disturbance. This area contains all of the currently-occupied and (since 1993) previously-occupied territories in the vicinity of Marana. These properties, because of their proximity to known owls and documented suitable habitat, receive the strictest disturbance limits. These limits are based on work done by AGFD which indicated that known pygmy-owl territories a mean disturbance of 33 percent within a territory. Based on this work, USFWS has required projects to be limited to between 20 and 30 percent disturbance in all previous section 7 consultations.

  There are 10,147 acres within Zone 1. Several developments, totaling 5,045 acres, have already completed section 7 or section 10 consultations, resulting in 3,427 acres of undisturbed habitat being set aside as mitigation land. Another 1,136 acres of land are restricted to no more than 30 percent disturbance through development agreement or zoning. An additional 2,858 acres of development is planned to occur over the next 25 years. This additional development will be limited to 20 to 30 percent disturbance but, with approval from USFWS, may be increased to 60 percent as long as adequate offsetting mitigation land is purchased elsewhere within the same critical habitat unit. The combination of existing section 7 mitigation land, existing disturbance restrictions on some developments, and a 30 percent disturbance limit on all future developments will result in a total of 5,956 acres of breeding habitat in Zone 1.

- In Zone 2, development is limited to 30 to 60 percent disturbance, depending on location within Marana. Approximately 19,230 acres of development is expected to occur in this zone over the next 25 years. There also is a 2,404-acre mitigation area that is under a 99-year lease as part of a previous section 7 consultation. Assuming the maximum 60 percent disturbance, with complete protection of the Tortolita SMA and the existing mitigation land, 10,096 acres of breeding habitat will remain in Zone 2 at full build out.

- Zone 3 does not contain suitable breeding habitat for the pygmy-owl and, therefore, has no maximum limit on surface disturbance. Proposed developments must leave undisturbed corridors through the property that are adequate to allow for dispersal of pygmy-owls. This area does not provide breeding habitat so the percent of land protected by the Zone 3 development restrictions is not estimated. The requirement for preservation of wash corridors will result in the protection of most or all potential dispersal corridors associated with washes of 500 cfs or greater.

Between Zones 1 and 2, 16,100 acres of undisturbed suitable habitat will remain on the east side of the Town. Given the current understanding of breeding territory size, this amount of habitat, if configured appropriately, could support up to 57 pairs of CFPOs. This estimate is based on a breeding territory size of 280-acres. However, the potential for this undisturbed habitat to contain some small or isolated fragments, the potential impacts associated with edge effects, and the patchy distribution of owls likely would result in fewer than this maximum number of owls being supported. The resulting habitat could, based on current understanding, support more owls than has previously been documented in Marana. The maximum number of owls ever documented within the planning area within a single year is 10.

Given the lack of known female owls within the planning area, the continuance of this local population is dependent on the ability of owls to disperse into Marana from other areas.

Since CFPOs rarely make flights greater than 100 ft and tend to avoid large open areas such as developments, golf courses, the connectivity of undisturbed habitat, both within the planning area, and from the planning area to suitable habitat outside of the Town, is very important. The contribution of habitat preserved within the Town is therefore a function of, not only acreage, but also the configuration of undisturbed open space. Under the HCP, the Town would require developers to address issues of natural undisturbed open space (NUOS) configuration, connectivity to other NUOS on-site and off-site, and potential wildlife movement corridors. Developers would be required to gain USFWS approval on the final site design, ensuring that these issues are adequately addressed.

Suitable CFPO habitat on the west of Interstate-10 is important, primarily, for connectivity between suitable habitat east of the interstate and habitat to the west of Marana. This connectivity will be preserved through the implementation of development guidelines restricting surface disturbance and requiring the appropriate configuration of undisturbed open space. Although this habitat is significant, first and foremost, as dispersal habitat, it is of sufficient quality to be utilized as breeding habitat although no CFPO territories have been documented in this area. Based on the potential of this habitat to support breeding activity, stricter development guidelines will be imposed than on habitat suitable for dispersal only (Zone 3 on the east side). The lack of documented owl territories is consistent with the situation in Zone 2, so the same development restrictions from this zone are applied west of I-10.

There are 3,810 acres of potential suitable in west Marana. Approximately, one-third of this habitat consists of previously developed land. Of the remaining 2,592 acres of undisturbed habitat in Marana, nearly 60 percent (1,507 acres) is located in the Santa Cruz River floodway. This area will be protected as undisturbed habitat under Burrowing Owl Measure - 1 (see *Section 4.3 Burrowing Owl* for the complete text of this measure). Another 474 acres of habitat has been set aside as conservation easements in existing developments. An additional 611 acres of development is planned to occur over the next 25 years. Assuming the maximum 60 percent disturbance in future developments, 2,225 acres (85%) of suitable habitat will be protected under this measure.

Roads and utilities also can act as impediments to owl movements. Any roads projects implemented by the Town would comply with the Pima County's environmentally sensitive road design guidelines or a similar standard. Utilities will be required to revegetate the majority of any cleared areas to minimize the width of open space that owls would have to cross. These measures will ensure that these linear projects do not isolate areas of suitable habitat by acting as barriers to pygmy-owl dispersal.

CFPOs can be negatively impacted by the indirect consequences of urbanization. Potential threats include increased harassment or predation from free-ranging pets or feral animals; indirect or intentional harassment from recreationists; nest cavity competition and exposure to disease from non-native birds, such as starlings, which are attracted to urbanized areas; and habitat degradation due to influx of non-native plant species from yards and landscaping. Under the HCP, the Town would require that mitigation lands be adequately managed to protect their suitability as pygmy-owl breeding and/or dispersal habitat. The mitigation lands must be kept in a natural condition; no development or other activities, except for some passive recreation will be permitted in these areas. Other restrictions will be placed on fencing, planting and landscaping, pets, and herbicide and pesticide use to

prevent degradation of the habitat. All mitigation areas must have an associated management plan, approved by USWFS.

CFPOs can be killed or injured when nest sites are destroyed during grading or other ground disturbance activities. Under the HCP, the Town will require the implementation of monitoring measures to prevent lethal take of any CFPOs. These measures include surveying for owls, starting two years before the initiation of a construction project and continuing until construction is completed, and compliance with the USFWS guidelines regarding appropriate modifications to a project if an owl is detected in the vicinity.

Overall, the Cactus Ferruginous Pygmy-Owl Conservation Strategy is anticipated to preserve 18,376 acres of suitable habitat (53% of the habitat within Marana), an amount sufficient to support the current known population of CFPOs and, given an optimal configuration, as many as 57 pairs of owls total. The strategy implements USFWS-developed guidelines to avoid lethal take of any CFPOs within the planning area as a result of the implementation of covered development activities. There is, therefore, no anticipated take of individual owls within the planning area under this strategy. If successful, implementation of the HCP would contribute to the conservation of pygmy-owls within the planning area.

Strategy B – Augmentation Approach

Based on the augmentation approach, proposed future development in the Town is predicted to directly impact about 9,361 acres of potential habitat for pygmy-owls in the Town. Approximately 25,544 acres of potential habitat would not be impacted by anticipated development. Although there appears to be a considerable amount of suitable habitat in the Town (about 34,905 acres), only three owls are known to currently inhabit the Town. The Town's conservation approach to pygmy-owls under this approach is to protect a sufficiently large area of suitable habitat (i.e., a preserve) to support a recovered owl population, maintain sufficient amount and configuration of breeding and dispersal habitat outside of the preserve in an effort to maintain the known owls in the Town, and augment the local population with birds from outside the planning area.

The Tortolita Preserve Expansion would consist of approximately 18,600 acres and would incorporate the existing 2,404-acre Tortolita Preserve. This preserve would be permanently acquired through purchase, land exchange, or another mechanism and would be managed as a pygmy-owl augmentation location, with only passive or low-intensity recreation activities allowed. Under the monitoring and adaptive management plan, the preserve would be managed to protect the integrity of the habitat (e.g., patrolling, vegetation management, feral and domestic animal control) and improve the likelihood of success for the augmentation effort (e.g., providing nest boxes and/or stock tanks).

Over the permit period, sufficient numbers of pygmy-owls will be relocated to the preserve to establish a self-sustaining population of owls. Given the current understanding of breeding territory size, this amount of habitat in the expanded preserve could support up to 66 pairs of CFPOs. This estimate is based on a breeding territory size of 280-acres; however, the potential for this impacts associated with edge effects and the patchy distribution of owls would likely mean that fewer than this maximum number of owls could be supported. If the augmentation program, over a number of years, is judged by USFWS to be unsuccessful, a contingency plan would be implemented (e.g., augmentation in other areas).

Under this strategy, areas outside the preserve can be developed more extensively (up to 60%) than is currently permitted, however, sufficient habitat will be protected and in an adequate configuration to allow for the dispersal of owls to and from the preserve and to avoid lethal take of existing owls. Although a greater percentage of disturbance is allowed outside of the preserve, development will be consistent with the maximum amount of disturbance that a pygmy-owl territory has been found to contain. These generous development standards are possible with the establishment of an alternative population source in an area of sufficient size and habitat integrity to allow for the persistence of these owls over the long-term. The 60 percent limit on disturbance and connectivity requirements will be ensured, in part, by the implementation of an ordinance or other legally binding mechanism (Measure B3). In addition, five 300-meter wide corridors will be protected along the largest washes flowing south from the preserve. Between these measures, another 3,140 acres of suitable habitat will be protected outside of the preserve and will maintain connectivity of the preserve to habitat to the south and east. Connectivity to the north will need to be addressed by others as it falls outside of the Town's jurisdiction. To the west, connectivity will be preserved through the protection of the larger wash corridors through habitat considered suitable for dispersal only.

Suitable CFPO habitat on the west of Interstate-10 is also important for connectivity between suitable habitat east of the interstate and habitat to the west of Marana. This connectivity will be preserved through the implementation of development guidelines restricting surface disturbance and requiring the appropriate configuration of undisturbed open space. Although this habitat is significant, first and foremost, as dispersal habitat, it is of sufficient quality to be utilized as breeding habitat although no CFPO territories have been documented in this area. Based on the potential of this habitat to support breeding activity, stricter development guidelines will be imposed than on habitat suitable for dispersal only (Zone 3 on the east side). The lack of documented owl territories is consistent with the situation in Zone 2, so the same development restrictions from this zone are applied west of I-10.

There 3,810 acres of potential suitable in west Marana. Approximately, one-third of this habitat consists of previously developed land. Of the remaining 2,592 acres of undisturbed habitat in Marana, nearly 60 percent (1,507 acres) is located in the Santa Cruz River floodway. This area will be protected as undisturbed habitat under Burrowing Owl Measure - 1 (see *Section 4.3 Burrowing Owl* for the complete text of this measure). Another 474 acres of habitat has been set aside as conservation easements in existing developments. An additional 611 acres of development is planned to occur over the next 25 years. Assuming the maximum 60 percent disturbance in future developments, 2,225 acres (85%) of suitable habitat will be protected under this measure.

Roads and utilities also can act as impediments to owl movements. Any roads projects implemented by the Town would comply with the Pima County's environmentally sensitive road design guidelines or a similar standard. Utilities will be required to revegetate the majority of any cleared areas to minimize the width of open space that owls would have to cross. These measures will ensure that these linear projects do not isolate areas of suitable habitat by acting as barriers to pygmy-owl dispersal.

CFPOs can be killed or injured when nest sites are destroyed during grading or other ground disturbance activities. Under the HCP, the Town will require project proponents to

coordinate with AGFD and USWFS to determine if any owls are located on the property in question and to modify such aspects of the project necessary to avoid lethal take of any CFPOs. These measures include surveying for owls, starting two years before the initiation of a construction project and continuing until construction is completed, and compliance with the USFWS guidelines regarding appropriate modifications to a project if an owl is detected in the vicinity.

Overall, the Cactus Ferruginous Pygmy-Owl Conservation Strategy is anticipated to preserve 25,544 acres of suitable habitat (73% of the habitat within Marana), an amount sufficient to support the current known population of CFPOs and, given an optimal configuration, as many as 91 pairs of owls, if established as a result of augmentation and the successful reproduction of augmented birds. The strategy implements measures to preserve connectivity of the preserve to habitat in all directions from the preserve. In addition, USFWS-developed guidelines will be implemented to avoid lethal take of any CFPOs within the planning area as a result of covered development activities. There is, therefore, no anticipated take of individual owls within the planning area under this strategy. If successful, implementation of the HCP would contribute to the conservation of pygmy-owls within the planning area and will, in fact, contribute to the recovery of the owl.

4.3 Burrowing Owl (*Athene cunicularia hypugaea*)

4.3.1 Population Status and Ecology

Range and Distribution

Burrowing owls are distributed throughout much of the western United States. The species' breeding range extends from southern Canada into the western half of the U.S. and south into Baja California, and central Mexico. The winter range is similar to the breeding range, except most owls from the northern areas of the Great Plains and Great Basin migrate south (Haug et al. 1993).

Arizona supports breeding and wintering birds (deVos 1989). Burrowing owls have been reported from 13 of 15 counties with breeding confirmed in 12 counties (Brown 2001b). Currently, the two major breeding populations in Arizona are in the Tucson area and the Yuma area (Brown 2001a). In Pima County, burrowing owls were reported in 5 United States Geological Survey quadrangles between 1993 and 1999: Childs Mountain, Cat Mountain, Palo Verde Camp, Tucson SW, and west of Marana (Arizona Breeding Bird Atlas 2000).

Seasonal movements by burrowing owls that breed in Arizona are unclear. Owls that breed in northern Arizona are thought to migrate in winter while in other portions of the state, owls may be year-round residents (Brown 2001b). Recent studies indicate that less than 40 percent of the burrowing owls present in Arizona during the summer spend the winter in Arizona (Brown and Mannan 2002). Owls from Canada and northern United States may winter in southern Arizona or migrate through this area on their way to overwintering areas in Mexico (James and Ethier 1989).

Population Status and Threats

Range-wide Population Status and Threats

Burrowing owls have declined in abundance throughout most of their range (Haug et al. 1993). In the western states, 54 percent of 24 jurisdictions reported burrowing-owl populations decreasing; there were no reported increases. Local populations are especially prone to extinction in this species (Haug et al. 1993). The species is listed as endangered or sensitive in 14 states in the U.S. and as threatened or endangered in four provinces in Canada. It has been petitioned for state listing in California.

Burrowing owls have declined through much of their range because of habitat loss associated with urbanization, agricultural conversion, and rodent control programs (Johnsgard 1988). Pesticides, predators, and vehicle collisions also have contributed to their decline (Haug et al. 1993; James and Espie 1997). Survival and reproductive success can be adversely affected by spraying insecticides over nesting colonies (James and Fox 1987). Burrowing owls also have been incidentally poisoned and their burrows destroyed during eradication programs aimed at rodent colonies (Collins 1979; Zarn 1974). Although burrowing owls are relatively tolerant of human activity, there are human-related impacts, such as shooting, burrow destruction, and the introduction of non-native predators, that adversely affect the owls (Zarn 1974; Haug et al. 1993). Populations of native predators (e.g., gray foxes and coyotes) artificially enhanced by development (i.e., availability of artificial

food sources and shelter) and introduced predators (e.g., red foxes, cats, and dogs) near burrowing owl colonies adversely impact this species (see e.g. Milsap 2002).

Arizona Population Status, and Threats

Burrowing owls are widely distributed but generally uncommon in Arizona (Brown 2001b). James and Espie (1997) estimated the burrowing owl population in Arizona to be between 100 and 1,000 birds although this estimate was based on questionnaires rather than a systematic survey. Burrowing owls are believed to have declined in abundance in Arizona (Brown 2001b; James and Espie 1997) principally as a result of the decline in the population of Gunnison's prairie dog (*Cynomys gunnisoni*) in northern Arizona and the extirpation of black-tailed prairie dogs (*Cynomys ludovicianus*) in southeastern Arizona (Brown 2001a). Loss of habitat resulting from shrub encroachment also has contributed to declines in parts of Arizona (Brown 2001a). Grazing practices and prairie dog control programs likely have encouraged shrub encroachment (Brown 2001a).

The breeding range of the owl in Arizona appears to be have been relatively stable in the 1990's (Arizona Breeding Bird Atlas 2000). Currently, there are two major breeding populations in Arizona, one in the Tucson area at Davis-Monthan Air Force Base and west branch Santa Cruz River flood plain (Estabrook and Mannan 1998) and one in the Yuma area where high numbers of burrowing owls have been reported along the irrigation canals. The urbanized area of Tucson, typically supports 80 to 110 active burrows with the numbers varying seasonally and annually (Estabrook and Mannan 1998). The size of the population in Yuma has not been estimated. Six nests were reported in the Phoenix Metro Area in 1994, 3 in 1995, and 5 to 6 in 1996 (Brown 2001a).

Brown (2001a) identified the following threats to burrowing owls in Arizona

- Reduced habitat availability because of prairie dog and ground squirrel control programs
- Bubonic plague indirectly limiting habitat availability through effects to prairie dogs and ground squirrels
- Conversion and urban development of natural habitat and agricultural lands
- Overgrazing of rangelands resulting in a more woody species composition and destruction of burrows
- Reduction of prey
- Maintenance programs of agricultural irrigation and water resources canals destroying burrows
- Urbanization increasing the risk of contracting *Trichomoniasis* from doves
- Urbanization increasing predation by domestic and/or feral animals, or children and potential for vehicle strikes
- Reduction in prairie dog and ground squirrel populations may increase predation of burrowing owls
- Agricultural pesticides.

Life History

Burrowing owls often live in colonies with many pairs nesting in burrows in close proximity. They are monogamous and generally produce one brood per season. Not all individuals capable of breeding do so every year. Breeding is initiated in early March. Eggs are laid from late March to July (Terres 1980). Clutch size averages 7 to 9 (Terres 1980). Young are born altricial and fledge in late summer to fall (Coulombe 1971). If the first clutch is lost, females may renest.

Hatching success has been reported to range from about 90 percent in Idaho to about 55 percent in California. Fledging success has ranged from 4.9 to 2.9 young per successful nest (Haug et al. 1993). Eastabrook and Mannan (1998) found 62.5 percent of 72 nests studied to be successful and 16.7 percent to have failed. The outcome of the remaining 20.1 percent was unknown.

Burrowing owls in northern Arizona generally migrate south during the winter, while in southern Arizona, many are year-round residents (Phillips et al. 1964). In the Tucson area, it appears that some burrowing owls are year-round residents while others are migratory (Estabrook and Mannan 1998).

Habitat Requirements

Burrowing owls inhabit open areas, such as grasslands, pastures, coastal dunes, desert scrub, and the edges of agricultural fields. They also inhabit golf courses, airports, cemeteries, vacant lots, and road embankments or wherever there is sufficient friable soil for a nesting burrow (Haug et al. 1993). In the Tucson area, nearly all (97%) of the burrows used for breeding were in undeveloped areas that had been cleared of native vegetation (Estabrook and Mannan 1998).

Burrows are a critical habitat requirement for burrowing owls. Owls use burrows for nesting and also require access to alternate burrows to provide escape cover for adults and fledglings. Estabrook and Mannan (1998) found that areas with many large burrows supported more owls than areas with fewer and/or smaller burrows. Because they do not excavate their own burrows, burrowing owls are dependent on fossorial mammals such as badgers (*Taxus taxidae*), ground squirrels and prairie dogs to create burrows. In Arizona, burrowing owls often inhabit areas supporting prairie dog (*Cynomys gunnisoni*) and round-tailed ground squirrel (*Spermophilus tereticaudus*) populations (deVos 1998; Brown 2001b). These burrowing mammals usually inhabit open environments and create burrows that the owls require as well as maintain vegetation at a short height (deVos 1998).

Burrowing owl nesting density appears to be strongly dependent on local burrow distribution and also may be influenced by foraging habitat quality. Reported nesting densities are highly variable, ranging from as dense as 3.1 acres per pair to 11,366 acres per pair (Table 4.3-1). Although somewhat colonial, burrowing owls maintain an exclusive area around their nest burrows. Reported nearest neighbor distances are more consistent than nesting densities and range from 197 feet to 787 feet (Table 4.3-2). Assuming a circular nesting territory, reported nearest neighbor distances translate into nesting territories ranging from 0.7 acres to 11.1 acres (Table 4.3-2).

TABLE 4.3-1
Density of burrowing owls in various areas

Location	Density (Acres/pair)	Reference
Lower Colorado River	3.1	Brown (1998, cited in TNC 1999)
Bay Area, California	5.9	Trulio (1997)
Oklahoma[a]	10	Zarn (1974)
Minnesota	14	(Grant 1965, cited in Milsap and Bear 2000)
Imperial Valley, California	30	Rosenberg and Haley (2001)
Florida	36	Milsap and Bear (2000)
Imperial Valley, California	29 to 53	Coulombe (1971)
Oklahoma[b]	11,366	Zarn (1974)

[a] In prairie dog towns
[b] More than 1 mile from a prairie dog town

TABLE 4.3-2
Nearest neighbor distances between burrowing owl nests

Location	Distance Feet (meters)	Acres[d]	Reference
Oakland, California	197 ft (60 m)	0.7	Thomsen (1971)
Nebraska	344 ft (105 m)[a]	2.1	Desmond et al. (1995)
Oregon	361 ft (110 m)	2.3	Green and Anthony (1989)
Nebraska	410 ft (125 m)[b]	3.0	Desmond et al. (1995)
Saskatchewan	525 ft (160 m)	5.0	Haug (1985, cited in Desmond et al. [1995])
New Mexico	545 ft (166 m)	5.4	Martin (1973)
Imperial Valley, California	545 ft (166 m)	5.4	Rosenberg and Haley (2001)
Florida	577 ft (176 m)	6.0	Milsap and Bear (2000)
Nebraska	787 ft (240 m)[c]	11.1	Desmond et al. (1995)
Median	**525 ft (160 m)**	**5.0**	

[a] Large prairie dog towns (≥35 ha)
[b] Small prairie dog towns (<35 ha)
[c] Badger burrows not in prairie dog towns
[d] Based on a circle with radius one-half the nearest neighbor distance

Home range and foraging area may overlap between different pairs, with only the burrow being actively defended (Coulombe 1971; Johnsgard 1988). Little information is available on home range size and foraging distances for burrowing owls. Rosenberg and Haley (2001) found that burrowing owls typically foraged in areas close to burrows with more than 80 percent of observations within 1,968 feet (600 m) of the burrow. This finding is similar to that of Haug and Oliphant (1990) who found 95 percent of telemetry points within this distance of a burrow. Depending on the method used to estimate home range size, average home range sizes range from 83 acres to 595 acres (Table 4.3-3). Rosenberg and Haley (2001) reported that home ranges overlapped by about 30 percent.

TABLE 4.3-3
Home range sizes (mean ± 1 s.d.) of burrowing owls

Location	Size (acres)	Method	Reference
Imperial Valley, California	112±45	Fixed kernel	Rosenberg and Haley (2001)
Imperial Valley, California	454±161	Adaptive kernel	Rosenberg and Haley (2001)
Imperial Valley, California	281±75	MCP[a]	Rosenberg and Haley (2001)
Saskatchewan	83±21	MCP	Sissons and Scalisi (2001)
Saskatchewan	123±34	Adaptive kernel	Sissons and Scalisi (2001)
Saskatchewan	595±170	MCP	Haug and Oliphant (1990)
Imperial Valley, California	452	MCP	Gervais et al. (2000)

[a] MCP – minimum convex polygon

Burrowing owls eat a variety of different prey items, including rodents, frogs, small birds, terrestrial and aquatic invertebrates, and carrion (Zarn 1974; Johnsgard 1988; Gervais et al. 2000). During the summer in Arizona, predominant prey items in pellets from burrowing owls were scorpion, beetles, locusts, and small rodents (Haug et al. 1993). Also, Estabrook and Mannan (1998) reported mourning doves in the diet of burrowing owls in an urban setting.

4.3.2 Existing Conditions

Population in and near the Town

Very little information is available on the number and distribution of burrowing owls in the Town of Marana. The only systematic survey for burrowing owls in the Town of Marana was conducted during June through September 2003 (Alanen, 2003). The surveys were focused on areas of potentially suitable habitat in the Town and much of the potentially suitable habitat was surveyed (Figure 4.3-1). This survey found one adult pair with two

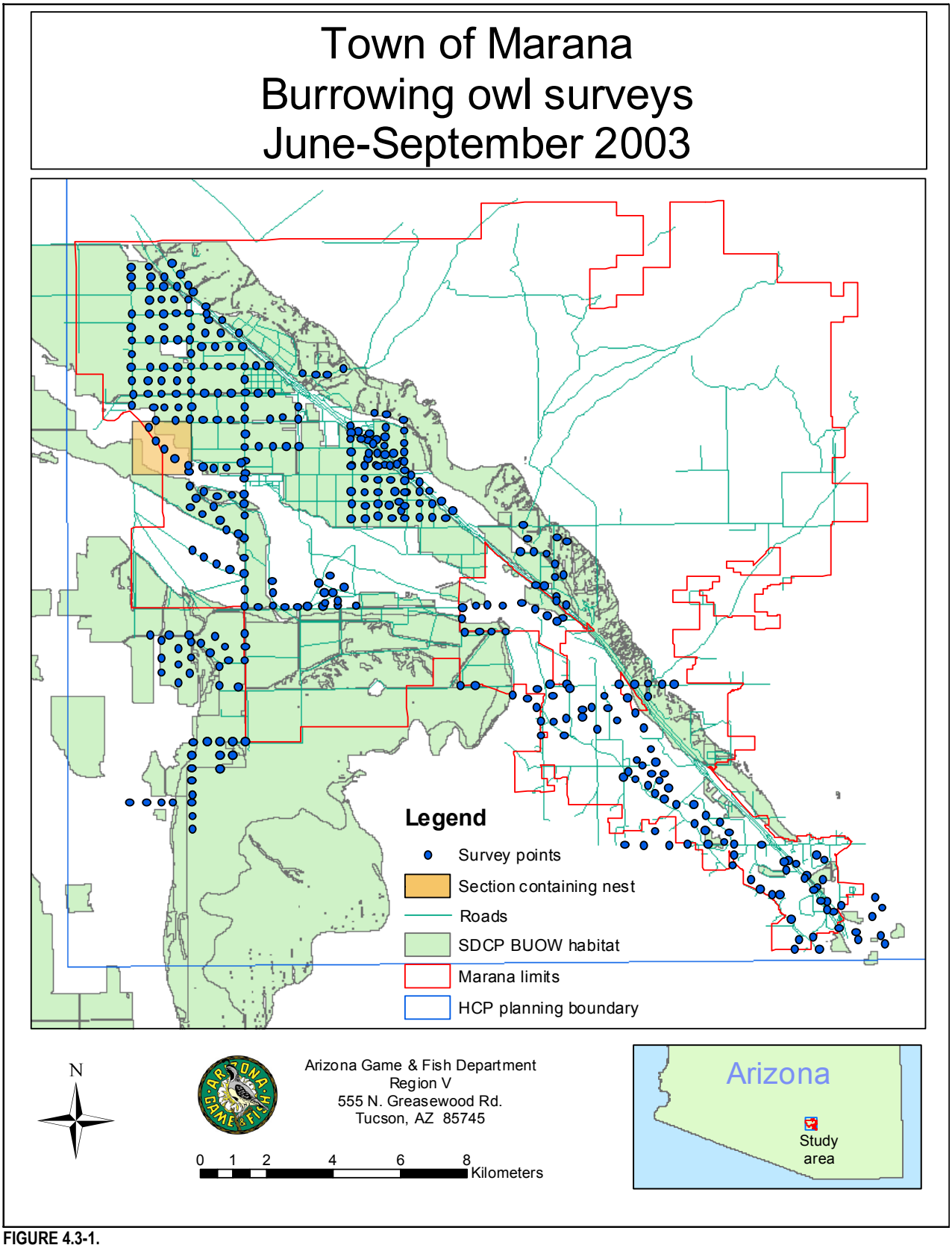

FIGURE 4.3-1.
Survey points for burrowing owls in the Town of Marana

juveniles within the Town limits. Several other burrowing owls were detected just outside the Town of Marana limits west of Trico Road. The surveys were conducted toward the end of and slightly after the recommended survey period of mid-March through mid-July. As a result, some owls may not have been detected.

In addition to this systematic survey, burrowing owls have been reported in the Marana area during AGFD's winter raptor surveys and there are several anecdotal reports of burrowing owls in and near Marana. Survey blocks 10A and 10B of ADGF's winter raptor survey cover Marana. Table 4.3-4 shows recent results for burrowing owls in these survey blocks. It is important to recognize that these surveys may be biased against sighting burrowing owls because surveyors typically focus on perches off the ground and therefore can miss burrowing owls which are typically at ground level.

TABLE 4.3-4
Number of burrowing owls reported in AGFD's winter raptor surveys for the two survey blocks (10A and 10B) that encompass the Town of Marana, Arizona.

Year	Survey Block 10A	Survey Block 10b
1997	1	N/A
1999	2	1
2000	1	1
2002	2	0

Source: Arizona Game and Fish Department, unpublished data.

Several reports place burrowing owls along Trico Road and near the Santa Cruz River (Alanen pers. comm., 2003; Alanen pers. comm. 2004c), at the Tucson Audubon Society's Simpson Farm property (Alanen pers. comm., 2004a), on the north side of Hardin Road east of Trico Road (Alanen pers. comm., 2004a), on the east side of Sandario Road just north of Emigh Road (Alanen pers. comm., 2004b) and at the Arthur Pack Desert Golf Course (Alanen 2003). Brown and Mannan (2002) reported one burrowing owl near the Marana Pinal Airpark and Brown (2001b) shows two occurrences of burrowing owls along I-10 in the vicinity of Marana. Local birders regularly report burrowing owls at the Marana pecan grove located outside the Town on Trico Road just north of the Santa Cruz River. These observations demonstrate the occurrence of burrowing owls in the vicinity of the Town and indicate the potential for burrowing owls to inhabit portions of the Town. Figure 4.3-2 displays the occurrences of burrowing owls relative to the Town boundary based on the survey results and anecdotal reports.

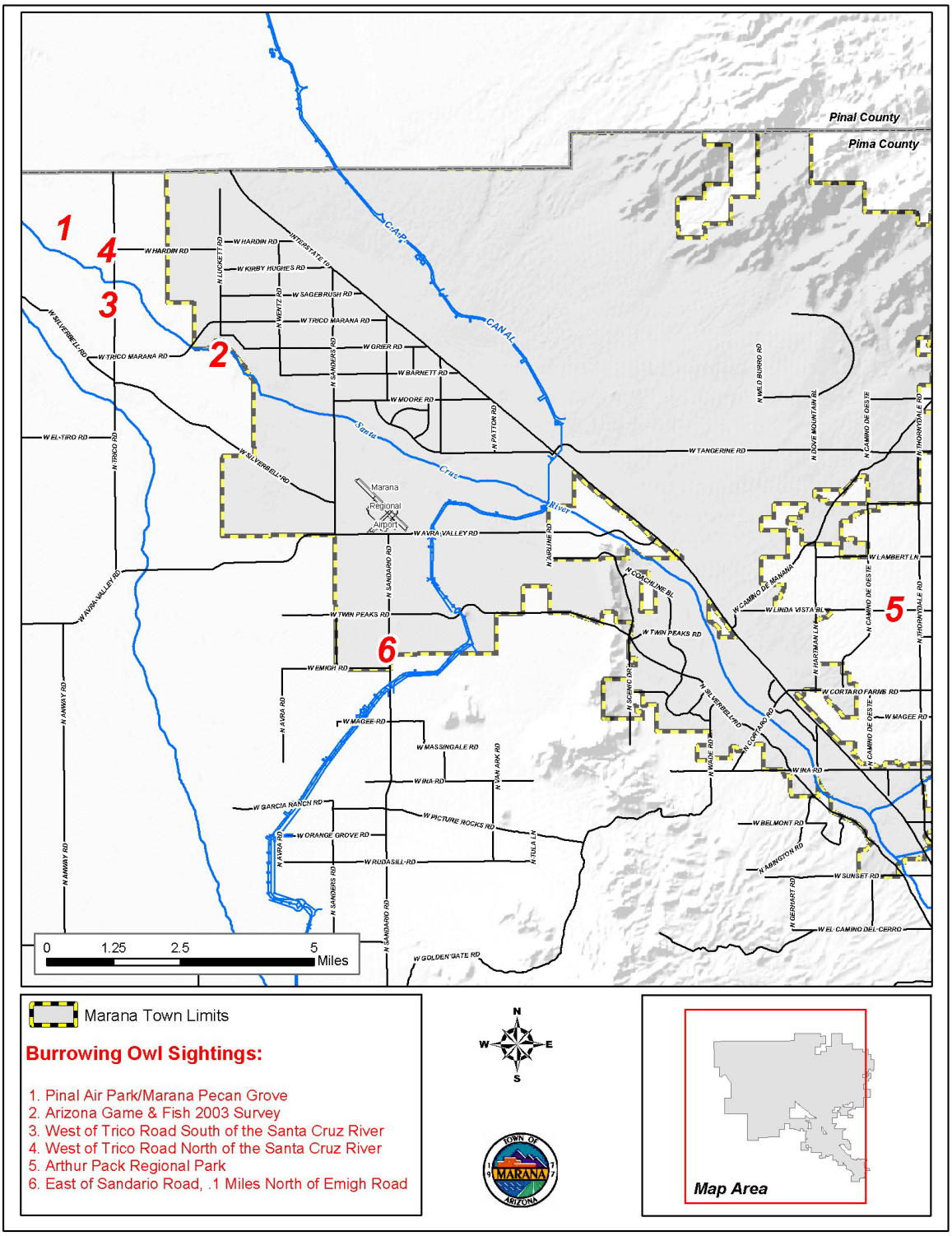

FIGURE 4.3-2.
Burrowing owl sightings near and within the Town of Marana

Habitat in and Near the Town

The habitat model for burrowing owls was specifically developed for the Town. The model was developed through expert opinion and field visits to areas potentially providing habitat in the Town. The burrowing owl habitat model consisted of two habitat designations—nesting habitat and foraging habitat. One primary variable, landform, was used for the model, and only the floodplain landform type was identified as suitable for owl nesting within the Town. Suitable nesting habitat was defined as the Santa Cruz River and Brawley Wash floodplain, minus river channels, adjacent riparian vegetation, active agriculture and developed areas.

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

Based on this habitat model, the majority of the owl's nesting habitat in the Town is near the Santa Cruz River corridor and southwest Marana. Most foraging habitat is in undeveloped land north and south of the river outside of the nesting habitat. The Town supports 7,225 acres of potential nesting/foraging habitat and 6,033 acres of foraging only habitat for a total of 13,258 acres. Figure 4.3-3 shows the distribution of potential burrowing owl habitat in the Town.

Relation to Species' Range and Ecology

Because the ecology of burrowing owls in Arizona is poorly understood, the specific role and contribution of habitat and the burrowing owl population in the Marana is unclear. The Town of Marana currently supports at least of one breeding pair of burrowing owls and could support several others. The long-term success of owls breeding in Marana has not been determined thus precluding an evaluation of whether the Marana area acts as a source or sink population.

Potentially, habitat in Marana could be important to birds from Canada and the northern United States that may winter in or migrate through southern Arizona. However, the extent of use of the Marana area by wintering and migrating birds has not been determined.

Local and regional movements of burrowing owls are largely unknown. Whether owls move between population centers in the Tucson area and the Phoenix area is not known. However, given Marana's location and the apparent availability of suitable habitat for burrowing owls, Marana could serve as a corridor for movement between these two populations as well as for seasonal migrations by owls between breeding and wintering grounds.

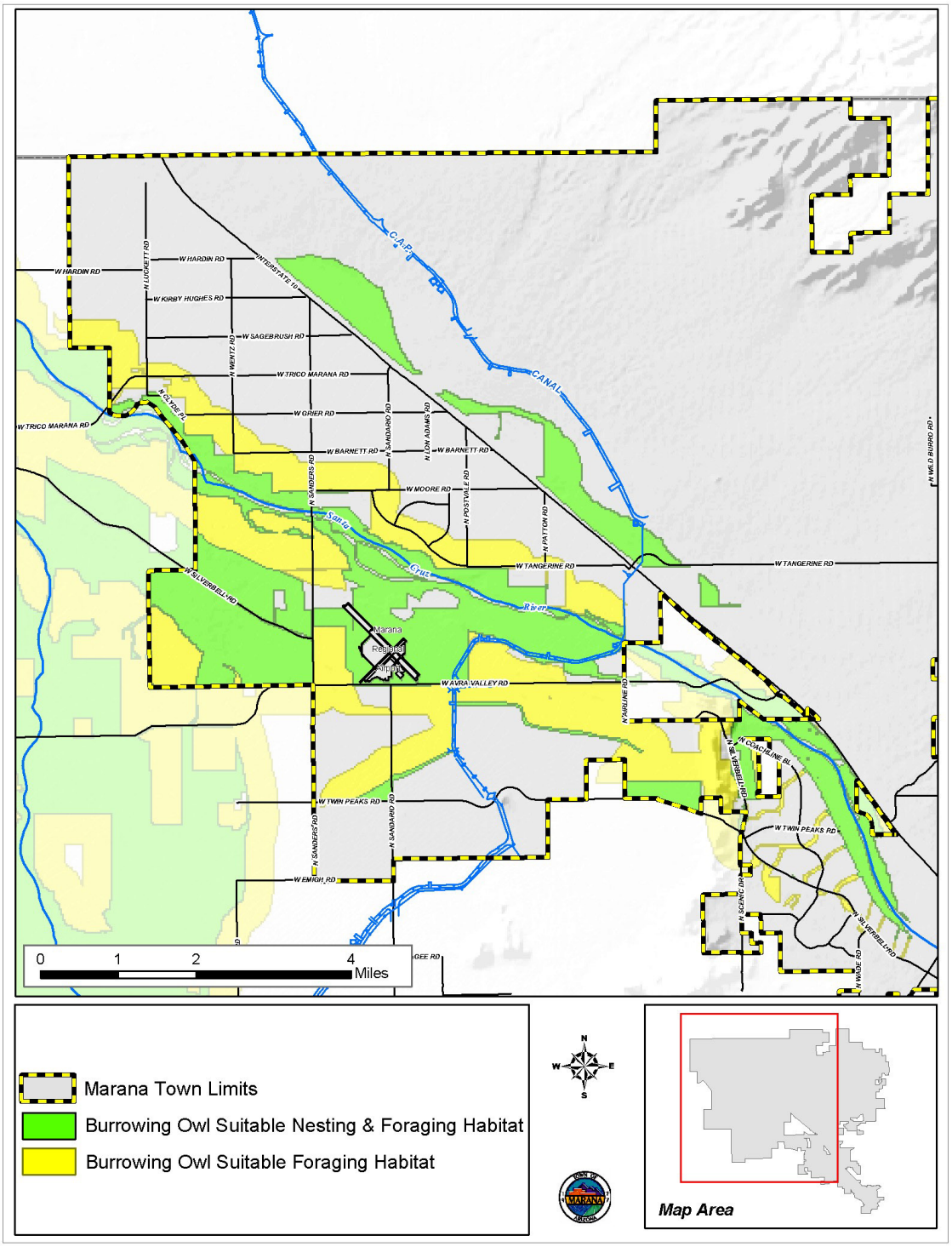

FIGURE 4.3-3.
Burrowing owl existing potential habitat.

4.3.3 Potential Impacts of Town's Proposed Activities

Direct Effects

Construction activities for new residential, commercial, and industrial development and supporting infrastructure has the potential to directly kill or injure owls by filling in or collapsing burrows. The number of owls potentially impacted in this manner is unclear but appears to be small. Surveys identified only one pair of burrowing owls in the Town. This pair is located in the Santa Cruz River floodplain and would not be directly affected by development. Whether additional pairs of owls are present in the Town and vulnerable to construction activities is not known. Also, the extent to which migrants winter in the Marana area is unknown. Depending on the timing of construction, wintering birds could be vulnerable to construction activities. No information is available to estimate the number of wintering birds potentially impacted.

Indirect Effects

Burrowing owls can be adversely affected through indirect mechanisms facilitated or caused by urban development. Burrowing owls are vulnerable to predation by domestic and feral cats whose numbers often increase in association with urban development. Other potential adverse effects to burrowing owls indirectly resulting from urban development include adverse effects from increased use of pesticides, increased disturbance from maintenance activities associated with drainageways, disturbance, injury or mortality from shooting or rock throwing and increased exposure to trichomoniasis. Vehicle strikes also can cause mortality of owls. Thus, the construction of new roads, widening of existing roads and increased population expected in Marana could contribute to mortality of resident and wintering burrowing owls. The small amount of information currently available suggests that only a small number of burrowing owls occur in the Town such that the impact of these activities in the Town on burrowing owls in probably small.

Changes in Habitat

Based on the Town of Marana's General Plan, a total of 8,986 acres of potential habitat (nesting/foraging and foraging only) for burrowing owls would be developed. Of this acreage, 7,050 acres would be in areas planned for high and moderate intensity development, 1,771 acres would be in low intensity areas, and 165 acres would be roads (Table 4.3-5). Because owls are somewhat tolerant of some types of human activity, suitable habitat could remain in some portions of the areas proposed for low intensity development and potentially in parks and schools associated with high intensity development areas. Under the proposed development, 4,272 acres of potential habitat for burrowing owls would remain in the Town (Figure 4.3-4).

TABLE 4.3-5
Existing acreage of burrowing owl habitat and projected future acreage burrowing owl habitat in the Town

	Nesting/Foragaing	Foraging Only	Total
Existing Acreage	**7,225**	**6,033**	**13,258**
Low intensity development	997	774	1,771
High intensity development	3,411	3,639	7,050
Roads	112	53	165
Total Impact	**4,520**	**4,466**	**8,986**
Total Unimpacted	**2,705**	**1,567**	**4,272**

It is important to recognize that not all of the potential habitat identified in the Town provides suitable habitat for burrowing owls or is used by owls. The habitat model identifies areas that could support burrowing owls based on vegetation characteristics and physical conditions but does not distinguish smaller scale conditions that determine where owls occur. For example, burrowing owl occurrence and abundance is strongly linked to the presence of burrows which was not specifically accounted for in the habitat model. Further, the burrowing owl survey information indicates that only a small number of owls inhabit the Town suggesting that only a portion of the potential habitat identified in the Town is occupied by owls.

Population Effects

Urban development could displace a small number of burrowing owls. If owls occupy areas proposed for development, future development in the Town could result in a small direct reduction in the local burrowing owl population. However, currently no burrowing owls are known to occupy areas proposed for development. Thus, whether this impact would occur is uncertain.

The level of use of habitats in Marana by wintering and migratory owls also is unclear. If habitats in Marana are used as wintering habitat by owls from within and outside of Arizona, then reductions in habitat from urban development could contribute to reductions in burrowing owl populations that nest elsewhere. Development in Marana could increase the vulnerability of owls that winter or migrate to vehicle collisions, predation, and exposure to disease. While it is conceivable that these types of impacts would result from future urban development, the number of owls affected and the impact on local and regional populations of burrowing owls is unclear.

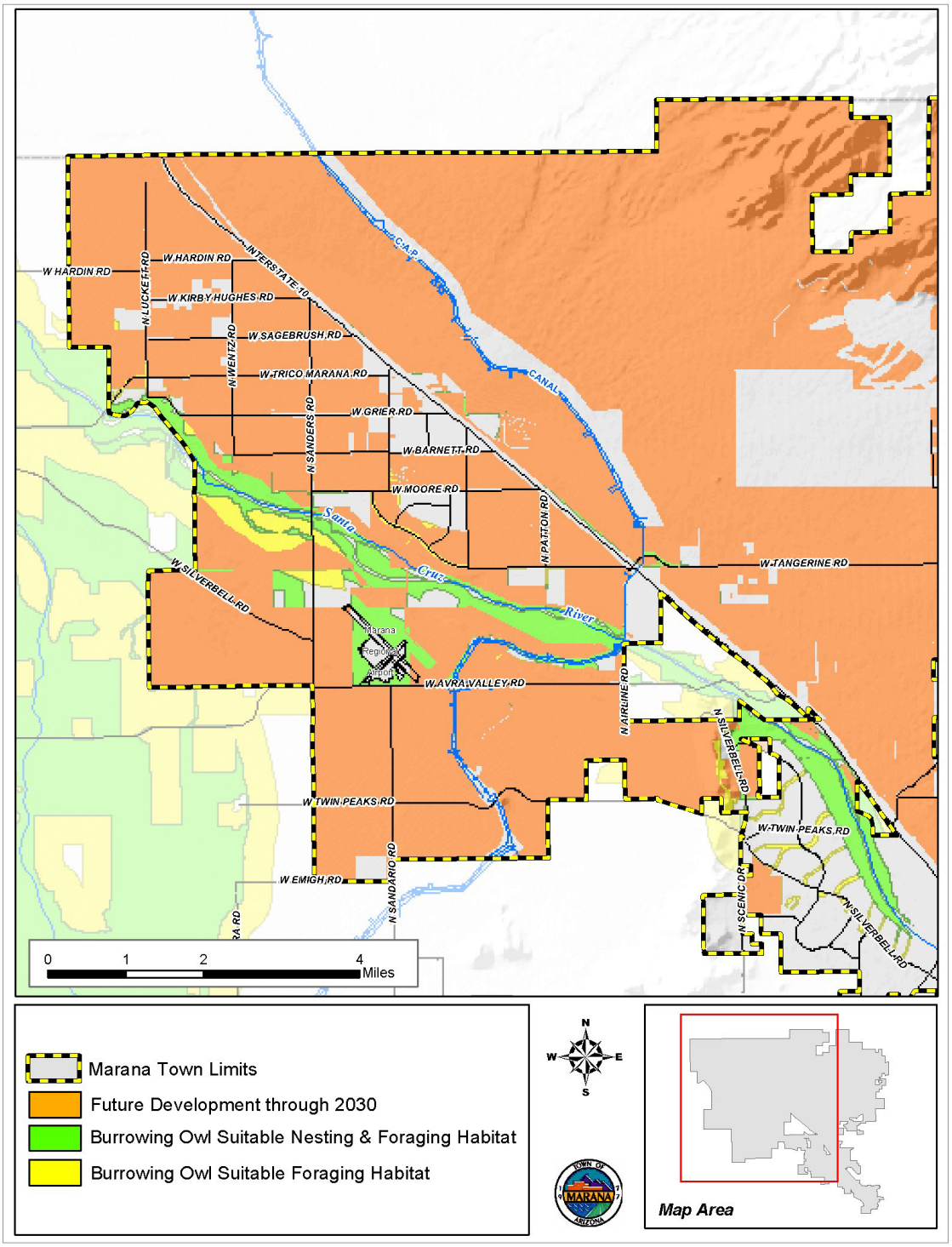

FIGURE 4.3-4.
Burrowing owl existing potential habitat with Marana planned future development through 2030.

4.3.4 Biological Goals and Objectives

As described above, the current level and pattern of use of the Town of Marana by burrowing owls is unclear. The Town is known to contain at least one breeding pair and the occurrence of breeding pairs nearby suggest the potential for more pairs in the Town. Similarly, burrowing owls are known to winter and migrate through southeastern Arizona but specific use of habitats in the Town for wintering and migration has not been verified. Based on this information, the Town's biological goals and objectives for burrowing owls relate to providing conditions to support breeding, wintering and migration by burrowing owls. Specifically, the Town's biological goal for burrowing owls is to

- Contribute to maintaining local and regional populations of burrowing owls.

The Town's specific objectives are to

- Increase the number of breeding pairs of burrowing owls in the Town and support breeding pairs in the Town over the HCP term, and
- Provide habitat for wintering and migrating birds.

4.3.5 Conservation Measures

Through implementation of the burrowing owl conservation program the Town seeks to make a positive and long-term contribution to the conservation of burrowing owls. The Town's conservation strategy for burrowing owls consists of actions to

- provide for the long term availability of nesting and foraging habitat,
- improve nesting habitat availability and quality,
- reduce adverse impacts from development and associated with urbanization, and
- promote integrated, regional conservation planning for burrowing owls.

The specific conservation measures that the Town will implement are detailed below. A monitoring and adaptive management program described following the conservation measures) complements these conservation measures.

Burrowing Owl Measure - 1. *The Town will prohibit, to the extent possible, development within the floodway of the Santa Cruz River. The Town will discourage those activities within the floodplain which are allowable under current zoning or permitting processes and which, if prohibited, could constitute a taking of property.*

Burrowing Owl Measure - 2 *The Town will establish at least 3 Burrowing Owl Management Areas (BOMAs) within 5 years of permit issuance. The Town will develop a management plan to maintain and/or create suitable nesting and foraging opportunities for burrowing owls in the BOMAs within 1 year of establishment of the first BOMA. The management plan will be amended to encompass management of the second and third BOMA as these areas are acquired in order to create a comprehensive and integrated management plan of the three areas. If artificial nesting structures are used, the Town will install up to 3 structures per acre in each BOMA. Burrowing owls will be*

allowed to independently colonize the BOMAs. Also, the Town will allow use of the BOMAs as hacking and release sites for burrowing owls relocated from other areas as long as it will not adversely affect owls already inhabiting the management areas.

The specific BOMAs will be determined through consultation with USFWS and AGFD. The Town will ensure the long-term conservation of the BOMAs through purchasing the land, obtaining a conservation easement or another mechanism approved by the USFWS.

The BOMAs will meet the following criteria unless otherwise approved by the USFWS:

- *Currently support nesting and foraging habitat for burrowing owls or be suitable for supporting nesting and foraging habitat with management*
- *Be in the Town of Marana*
- *Be at least 20 acres in size.*
- *Be contiguous with or within at least 100 feet of suitable foraging habitat that is expected to remain as foraging habitat over the term of the permit (e.g., be located in a designated open space)*

In addition, the 3 BOMAs must be located in 3 separate, non-contiguous areas. The Town will obtain written approval from the USFWS on the BOMAs.

Burrowing Owl Measure – 3. *For projects determined to support or potentially support burrowing owls through general biological surveys, surveys for burrowing owls will be conducted within 1 year prior to initiation of construction activities. Surveys will be conducted between April 15 and July 15. If burrowing owls are found, they will be passively evicted before initiation of construction activities. Burrowing owls will be evicted between September 1 and January 31, the non-breeding season. In addition, a clearance survey for burrowing owls of proposed project areas will be conducted within 30 days of initiation of construction activities. If burrowing owls are found, the owls will be evicted prior to the start of construction. If eviction of owls during the breeding season is necessary, the project proponent will coordinate with the USFWS and AGFD to evict the owls in a manner that minimizes potential harm to adults and nestlings.*

Burrowing Owl Measure – 4. *The Town will implement an education program to inform the public about burrowing owls and the Town's conservation program for burrowing owls. The education program will target three main groups:*

- *Residents living near BOMAs*
- *Recreationists using public parks encompassing BOMAs*
- *School children attending schools near BOMAs.*

The resident education program will focus on informing residents living near BOMAs about the potential impacts to burrowing owls from free-ranging cats and to encourage cat owners to keep cats indoors. The recreationist education program will inform people about the presence of the BOMAs, provide basic information about the species' ecology and inform the public about recreational activities potentially harmful to owls. The school children education program will teach children about burrowing owls, the Town's conservation efforts and activities that may be harmful to

burrowing owls. The Town will initiate the education program within 1 year of establishing the BOMAs.

Burrowing Owl Measure – 5. *The Town will inform neighboring jurisdictions about the Town's conservation program for burrowing owls and encourage implementation of compatible conservation measures by these jurisdictions. The Town will coordinate with regional conservation efforts for burrowing owls in implementing its conservation program and encourage other jurisdictions to coordinate conservation actions for burrowing owls at a regional level.*

4.3.6 Monitoring and Adaptive Management

Monitoring the effectiveness of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its 5-Point Policy Guidance (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

1. *Compliance monitoring* – Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.
2. *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring.

Compliance Monitoring and Reporting

Compliance monitoring and reporting will be accomplished through submittal of annual reports documenting progress toward and completion of the conservation commitments.

1. The Town will submit annual reports to the USFWS that include the following information:
    - Activities permitted or implemented by the Town in the floodway of the Santa Cruz River during the preceding year
    - Results of any project specific surveys for burrowing owls required under Burrowing Owl Measure – 3, including information on the areas that were surveyed; the number, pair and reproductive status (if determined) and location of burrowing owls found during the surveys; whether owls were relocated and the outcome of the relocations if known.
    - Activities conducted in implementing the education programs
    - Activities undertaken to coordinate with neighboring jurisdictions and regional conservation efforts

2. Upon establishment of a BOMA, the Town will demonstrate to the USFWS proof of ownership or proof of establishment of a conservation easement for the BOMA.

3. The Town will provide copies of BOMA management plans to the USFWS.

Effectiveness Monitoring and Reporting

As noted above, effectiveness monitoring focuses on whether the HCP measures are achieving the biological goals and objectives. The biological goal for the Burrowing Owl Conservation Strategy is to contribute to maintaining local and regional populations of burrowing owls. The specific biological objectives are to

- Increase the number of breeding pairs of burrowing owls in the Town and support breeding pairs in the Town over the HCP term, and
- Provide habitat for wintering and migrating birds.

The framework for effectiveness monitoring and adaptive management consists of a series of benchmarks at which progress toward the overall goal is assessed and adjustments in management of the BOMAs implemented if the benchmarks are not achieved. Surveys for burrowing owls in the BOMAs and habitat assessments of the BOMAs provide the data for assessing progress relative to the benchmarks.

Annuals Surveys of BOMAs

Once a BOMA is established and artificial burrows are installed and/or other management actions to establish breeding birds have been implemented, the Town will conduct annual surveys of the BOMAs for burrowing owls and to assess habitat conditions. Burrowing owl surveys will consist of call surveys during the breeding season to determine the number of owls occupying the BOMA, nesting status and reproductive success. An annual banding program will be implemented to band resident owls and young.

Habitat conditions in the BOMAs will be documented annually through collection of quantitative data on vegetation structure and density and photographs augmented with field notes. Vegetation data will be collected along 50-m long line transects as described in Estabrook (1999). Vegetation characteristics to be measured will include

- Percent cover of ground vegetation (e.g., grasses, forbs, shrubs)
- Percent cover of canopy vegetation (i.e., trees)
- Percent bare ground
- Height of all shrubs and trees encountered along the transect, and
- Vertical vegetation structure.

Permanent transect locations will be established throughout the BOMA at a sufficient density and distribution to encompass and characterize the range of variation in vegetation characteristics of the BOMA. The number and specific location of the transects may be influenced by how many and where artificial burrows are installed and therefore will be specified when the management plan for the BOMAs is developed (see Burrowing Owl Measure – 2).

During burrowing owl surveys, banding activities and habitat assessments, field personnel will record observations of dead or injured burrowing owls. Where possible, the cause of

the mortality or injury will be documented through field notes and photographs. In addition, field personnel will record through field notes and/or photographs, observations or evidence of potential mortality sources for burrowing owls in the BOMAs. Known or suspected causes of mortality for burrowing owls include, but are not limited to

- Predation by natural predators
- Predation by feral and domestic animals
- Incidental or intentional shooting
- Rock throwing
- Vehicle strikes
- Exposure to agricultural pesticides.
- Collapse of burrows from heavy equipment operation

Field personnel will document through field notes and/or photographs, observations germane to these potential mortality sources.

The Town will submit annuals reports to the USFWS of the results of the burrowing owl surveys, banding program and habitat assessment.

Effectiveness Assessment and Adaptive Management

Results from the annual surveys of the BOMAs will be used to assess progress toward achieving the biological goals and objectives of the Burrowing Owl Conservation Strategy. The benchmarks and the procedure for evaluating the success of each BOMA are as follows.

Benchmark 1*: Within 5 years of establishing a BOMA and implementing enhancement actions, the BOMA will be considered successful if:*

- *At least one burrowing owl pair has occupied the BOMA during the breeding season in at least one year*
- *Burrowing owls occupying the BOMA have successfully bred (i.e., produced at least 1 fledgling) in at least one year*

The goal and objectives of the Burrowing Owl Conservation Strategy relate to establishment of multiple breeding territories in the BOMAs. Benchmark 1 encompasses the first steps toward these objectives by considering whether the BOMAs are attractive to burrowing owls and whether they have the resources necessary to support a breeding pair.

If the success criteria for Benchmark 1 are not met, then the Town will confer with the USFWS and other appropriate burrowing owl experts to review the information from the annual surveys and habitat assessments of the BOMAs and other relevant information (e.g., regional information on the status, distribution and trends in burrowing owls, habitat conditions of areas known to be occupied by burrowing owls). Based on this review the Town and USFWS will identify management adjustments to improve the likelihood of meeting the success criteria. Management adjustments that the Town would implement may include activities such as

- installing different types of nesting structures,
- changing vegetation management practices,
- releasing or hacking burrowing owls,

- enacting ordinances to reduce specific sources of mortality or disturbance (e.g., restrictions on free-ranging cats),
- modifying or enhancing educational programs,
- installing fencing or
- implementing other measures consist with these types of activities.

Management adjustments will not require an additional commitment of land, money or water. In addition, if installation of a different type of nesting structure is recommended, the type will be generally consistent in terms of cost to construct, install and maintain as current structures. Annual monitoring of burrowing owls and habitat conditions will continue with a review of the monitoring results every 5 years and management recommendations continuing until achievement of Benchmark 1 or the end of the permit period.

Benchmark 2*: Within 5 years of achieving Benchmark 1, the BOMA will be considered successful if:*

- *Multiple pairs of burrowing owls occupy the BOMA during the breeding season in at least 50 percent of the years*
- *At least 50 percent of the nesting pairs in the BOMAs, successfully fledged young.*

The success criteria of Benchmark 2 provide measurable criteria for evaluating the effectiveness of the BOMAs in supporting breeding pairs of burrowing owls over several years, and in providing habitat conditions sufficient for the owls to breed successful. They directly relate to the effectiveness of the BOMAs in meeting the biological goals and objectives, namely increasing the number of breeding pairs and contributing to maintaining local and regional populations.

As under Benchmark 1, if the success criteria of Benchmark 2 are not met, then the Town will meet with the USFWS and other appropriate burrowing owl experts to review the information from the annual surveys and habitat assessments and other relevant information (e.g., regional information on the status, distribution and trends in burrowing owls, habitat conditions at other areas occupied by burrowing owls), and to identify management adjustments to improve the likelihood of meeting the success criteria. The scope of potential management adjustments are as described for Benchmark 1. Annual monitoring, and 5 year reviews with management recommendations will continue until achievement of Benchmark 2 or the end of the permit term.

On-Going Monitoring and Adaptive Management

Following achievement of Benchmark 2, the Town will continue to annually monitor burrowing owls in the BOMAs throughout the term of the permit. The Town will continue to meet with the USFWS and other burrowing owl experts every 5 years for the term of the permit to verify continued achievement of the biological goals and objectives. If the annual surveys reveal that Benchmark 2 is no longer met, the Town, USFWS and other experts as appropriate will identify management adjustments to regain this benchmark.

4.3.7 Effects of Implementing the HCP on Burrowing Owls

Proposed future development in the Town could directly impact up to 9,000 acres of potential habitat for burrowing owls in the Town during the term of the permit. About 4,000

acres of potential habitat would not be impacted by potential development. Although there appears to be a considerable amount of suitable habitat in the Town (about 13,000 acres), existing information suggests that few owls inhabit the Town. The Town's conservation approach to burrowing owls is to proactively create and manage designated areas specifically for burrowing owls in an effort to attract and maintain burrowing owls in the Town.

Under the HCP, the Town would establish at least three management areas for burrowing owls and prohibit development activities to the extent possible within the floodplain of the Santa Cruz River. The management areas would be at least 20 acres in size and managed specifically to provide nesting opportunities for burrowing owls. As shown in Table 4.3-2, the median territory size based on nearest neighbor distances is 5 acres. Based on this territory size, each BOMA could support 4 pairs of burrowing owls for a total of 12 pairs within the designated BOMAs.

The location of these management areas has not been finalized but several potential areas have been identified (Figure 4.3-5). Under the HCP, the Town would work with burrowing owl experts to assess conditions at these potential areas, select areas to use as BOMAs and develop management plans to establish, improve and maintain habitat quality for burrowing owls. The specific actions to be undertaken will depend on the unique characteristics of each site but will specifically focus on providing nesting opportunities for burrowing owls such as installing artificial burrows. Although provision of nesting opportunities is the primary focus for burrowing owls, BOMAs also will be managed to provide foraging opportunities.

A total of 4,272 acres of nesting and foraging habitat would not be converted to urban uses with 2,083 acres encompassed by the floodway development restrictions of Burrowing Owl Measure – 1. The amount of foraging habitat required by a pair of burrowing owls in this environment is unknown. Home range studies conducted in other locations provide some indication of the area needed to support a pair of burrowing owls. Based on the studies summarized in Table 4.3-3, burrowing owl home ranges average 313 acres using the minimum convex polygon approach and 288 acres using the adaptive kernal approach. Assuming both members of a pair forage in the same general area surrounding the burrow, these averages yield a range of 3,456 to 3,756 acres to accommodate foraging ranges of 12 pairs of owls. More than this amount of foraging habitat would remain in the Town under its proposed development and about 60 percent of the remaining habitat would be in the floodplain. It is important to recognize that the estimates of the number of pairs of owls potentially supported in the Town are based on average values from studies conducted in other locations. The actual number of owls supported in the Town may be higher or lower than these estimates depending on the site specific conditions in the Town and local and regional population dynamics. The Town's commitment to allow use of the management areas as hacking or release sites for birds from other locations increases the likelihood that burrowing owls will become established in the management areas.

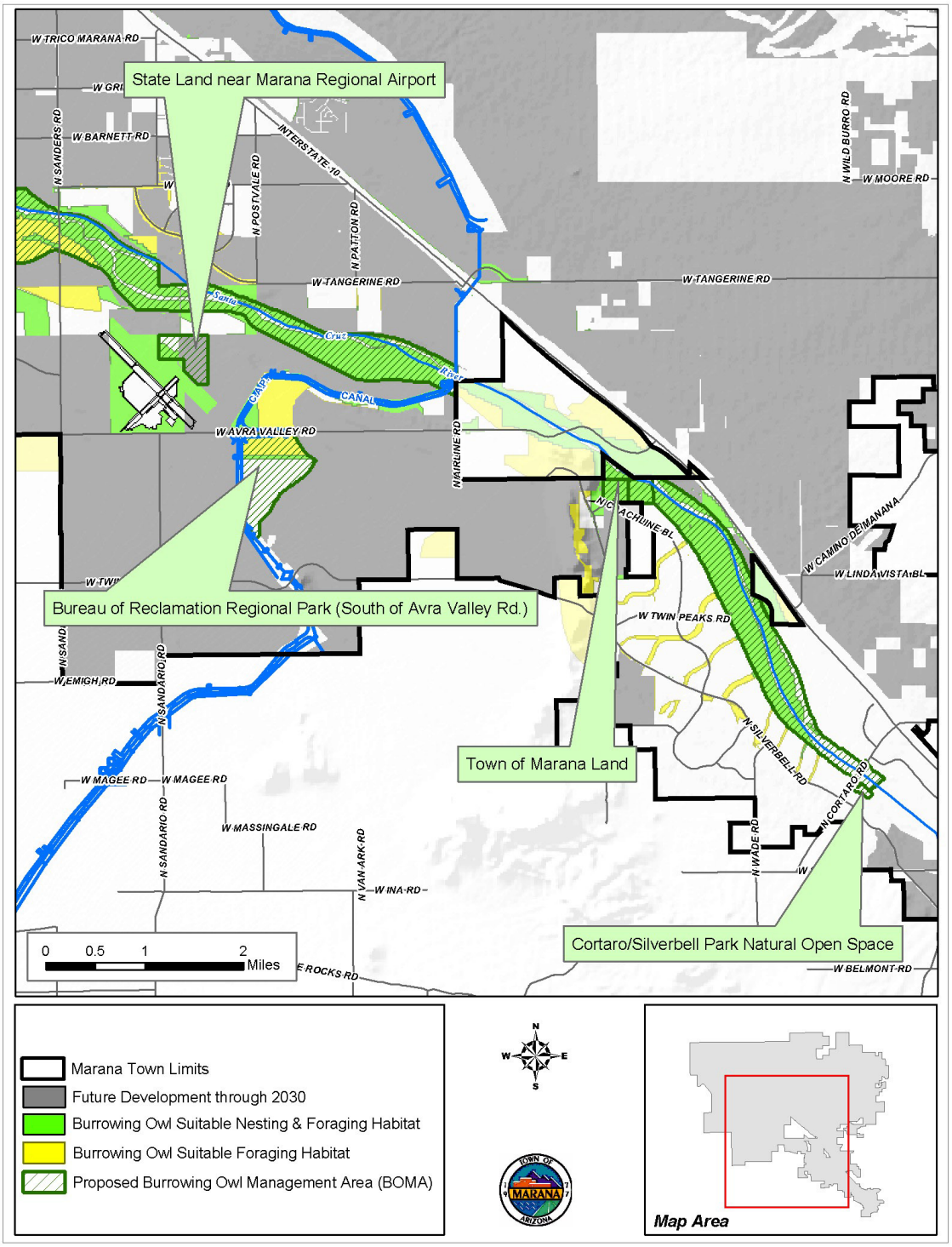

FIGURE 4.3-5.
Potential BOMAs within the Town of Marana.

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

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

Burrowing owls can be killed or injured during construction activities that collapse their burrows. Milsap and Bear (2000) found that nest destruction during construction activities was the leading cause of nest failure in their Florida study area. To minimize this potential direct impact under the HCP, the Town will require developers to conduct surveys for burrowing owls prior to construction and if burrowing owls are found to passively evict the owls before beginning construction. By evicting the owls, the potential for mortality or injury from construction activities will be reduced.

Passively evicting owls from burrows is commonly used to avoid direct impacts from construction and has generally been more successful in terms of owls becoming established at a new location than active relocation where owls are captured and released at new location (Trulio 1997). While evicting owls will reduce the likelihood of mortality or injury form construction activities, the long-term survival of evicted owls will depend on the availability and location of alternate habitat. Evicted owls have been reported to successfully colonize nearby burrows soon (within 1 week to 1 month) after eviction (Smith and Belthoff 2001; Trulio 1995). However, in other cases evicted owls could not be found at a new location (Feeney 1997; Smith and Belthoff 2001). The number of owls that would be affected by this measure over the term of the HCP is unknown. Currently, no owls are known to inhabit areas where new development would occur.

Overall, the Burrowing Owl Conservation Strategy is anticipated to increase the population of burrowing owls in the Town by ensuring the long-term availability of nesting and

foraging habitat and proactively improving nesting opportunities for burrowing owls. If successful, implementation of the HCP would contribute to the conservation of local and regional populations of burrowing owls.

4.4 Ground Snake (valley form) (*Sonora semiannulata*)

4.4.1 Population Status and Ecology

Range and Distribution

This range of the ground snake extends from southwestern Idaho south through western and southern Arizona; eastward through much of west and central Texas including nearly all of Oklahoma; and south through north-central Mexico. It is found from sea level to around 6,000 feet (1,830 meters) (Stebbins 1985).

The ground snake has distinctive and potentially isolated forms throughout its range. RECON (2002) describes three forms (e.g., varieties, morphs, subpopulations, and populations) as occurring within Pima County. The ground snakes in the Marana area are described as the valley form. The degree of genetic separation among local populations is unknown. The population's (valley form) range in the Marana region is described as extending from the Marana area northwest to Eloy (RECON 2002). Rosen (2003a) uses the term 'population segment' in referring to this population. Rosen (2004) provides a map (Figure 4.4-1) of the species' known distribution in Pima County and adjoining areas.

Population Status and Threats

The population status of this species in Arizona and Pima County is unknown. This species is not tracked by the Arizona Game & Fish Department's (AGFD) Heritage Data Management System. Recent surveys have confirmed that the species persists within the range of the valley form (Rosen 2004), but its population status is unknown. Rosen (2003a) believes habitat destruction, particularly in Pinal County, could be adversely affecting the local population. Other threats are likely to be similar to those for other snakes, and include:

- Agriculture and urban development.
- New road construction.
- Increased traffic on new and existing roads.
- Off road vehicle activity.
- Scientific and commercial collection.

Life History

The ground snake is a small, harmless snake whose prey includes insects, scorpions, centipedes, crickets, and grasshoppers (Rosen 2003a, Stebbins 1985). Unlike other closely related snakes, the ground snake is not morphologically adapted to digging (Rosen 2004). It is a secretive nocturnal snake. Clutches of 4 to 6 eggs are laid in June through August. This species is active during April through October and hibernates in underground dens during the winter (Stebbins 1985).

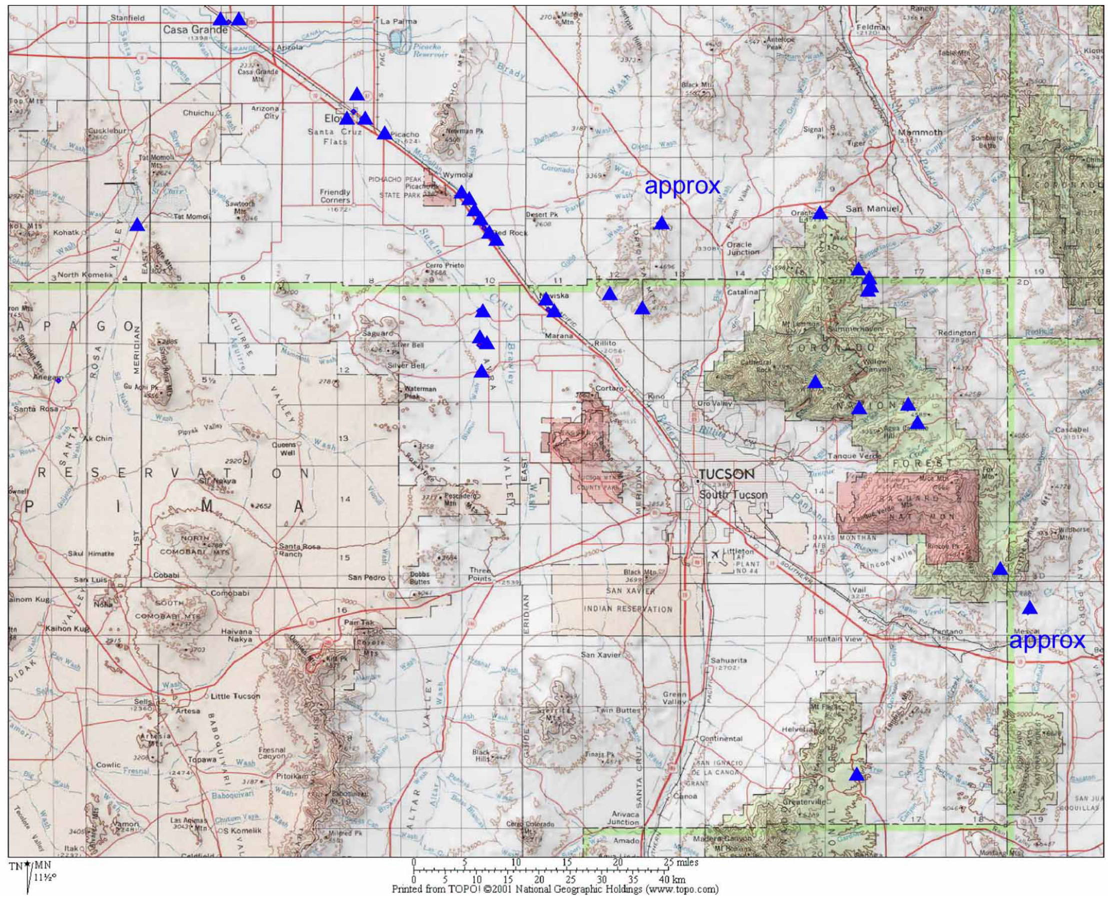

FIGURE 4.4-1.
Distribution of Ground Snake (*Sonora semiannualta*) in eastern Pima County and adjoining areas , Arizona, based on plotable museum records, 1900-2004, and observations and reliable records obtained by the author. Records occur in two environments: valley flats (mesquite- and grass-dominated desertscrub) and lower mountain slopes (semi-desert grasssland and upper edge of Arizona Upland desertscrub). Base image from TOPO! digital mapware. (Reproduced from Rosen 2004)

Habitat Requirements

The ground snake occupies desert valleys on hard clays and silts that digging snakes, such as shovel nosed snakes, cannot readily dig into (Rosen 2003a). Over its range, the species occurs in river bottoms, desert flats, sand hummocks, and rocky hillsides where there are pockets of loose soil. Vegetation is typically sparse as in creosote bush desertscrub, but along the lower Colorado River this snake occurs in thickets of mesquite (*Prosopsis* spp.) (Stebbins 1985). Rosen (2004) recently described the valley form's habitats as valley flats of mesquite and grass-dominated desertscrub, and lower mountain slopes of semi-desert grasssland and upper edge of Arizona Upland desertscrub.

In the Phoenix metropolitan area ground snakes are known to occupy urban environments. It does best in open areas with established vegetation, including landscaped areas that are untended by typical landscape management practices (Rosen, personal communication). However, there is no evidence that valley form of the species occupies urban environments in Pima County (RECON 2002).

4.4.2 Existing Conditions

Population in and near the Town

Documented locations of the ground snakes in and near the Town are shown in Figure 4.4-2 based on the most current information provided by Rosen (2004). Three locations are within the Town's boundary, confirming the species presence within the Town. However, these observations are not sufficient to determine the abundance or population status of the species in or adjacent to the Town.

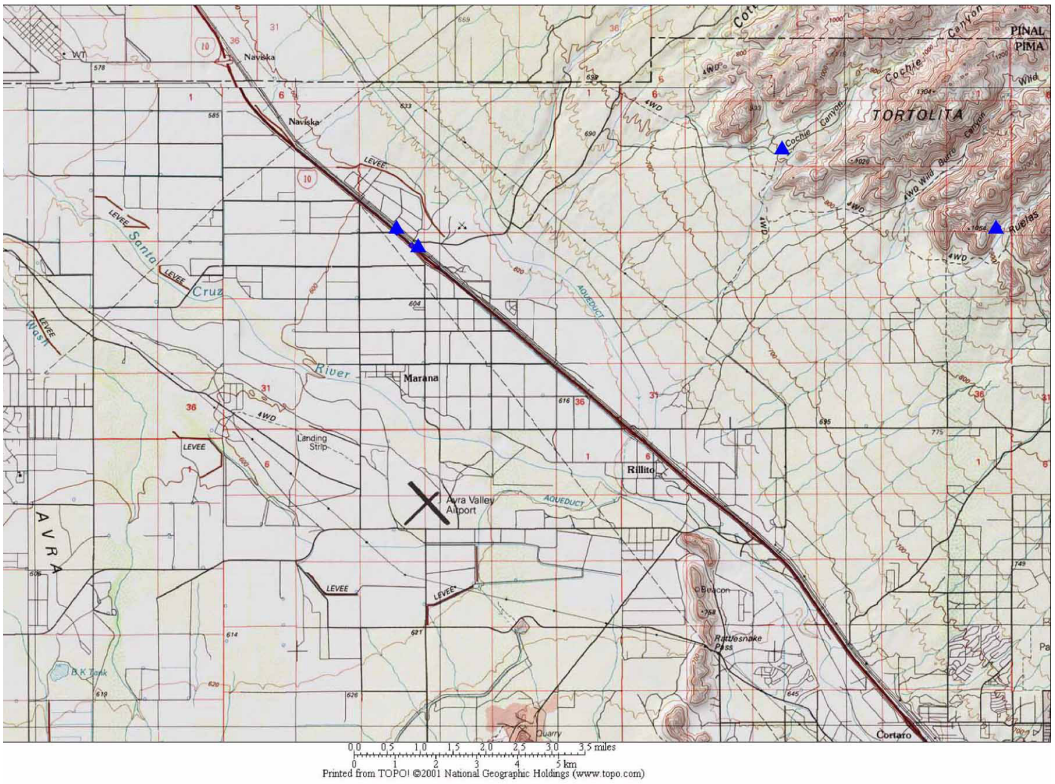

FIGURE 4.4-2
Known distribution of the Ground Snake in the Marana area as of June 2004. The location of the north-most record in Tortolita Mountains is in Cochie Canyon, and is not precisely given. (Adapted from Rosen 2004)

Habitat in and near the Town

Rosen (2004) recently concluded that ground snakes formerly occupied narrow bands of habitat on the periphery of the valley center where bajada washes discharged water and fine sediment on dense xero-riparian plains. He speculated that the ground snake's preferred habitat is the denser soils of the Brawley Wash floodplain. However, it appears unlikely that a population of the ground snake in this area would extend into the Town (Rosen 2004). Potential habitat, and possibly former habitat, includes portions of the Town and extends as

far south as Avra Valley Road. The heavy soils of the valley bottom in the Town have the required soil conditions favored by the ground snake (Rosen 2003a).

A habitat model, developed by Dr. Phil Rosen for the Marana draft HCP, used three primary variables: 1) soils, 2) slope, and 3) vegetation. The habitat value of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat value and 3 indicating that the category provided high habitat value. The three variables were combined to provide an overall habitat value (Table 4.4-1).

TABLE 4.4-1
Habitat model for the Ground Snake (valley form). Value ratings recommended by Dr. Phil Rosen

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

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

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

The output of the habitat suitability model for the ground snake is shown in Figure 4.4-3 with arrows indicating additional areas that could provide suitable habitat based on observations by Rosen (2004). Based on this model 10,349 acres of suitable ground snake habitat currently exists in the Town.

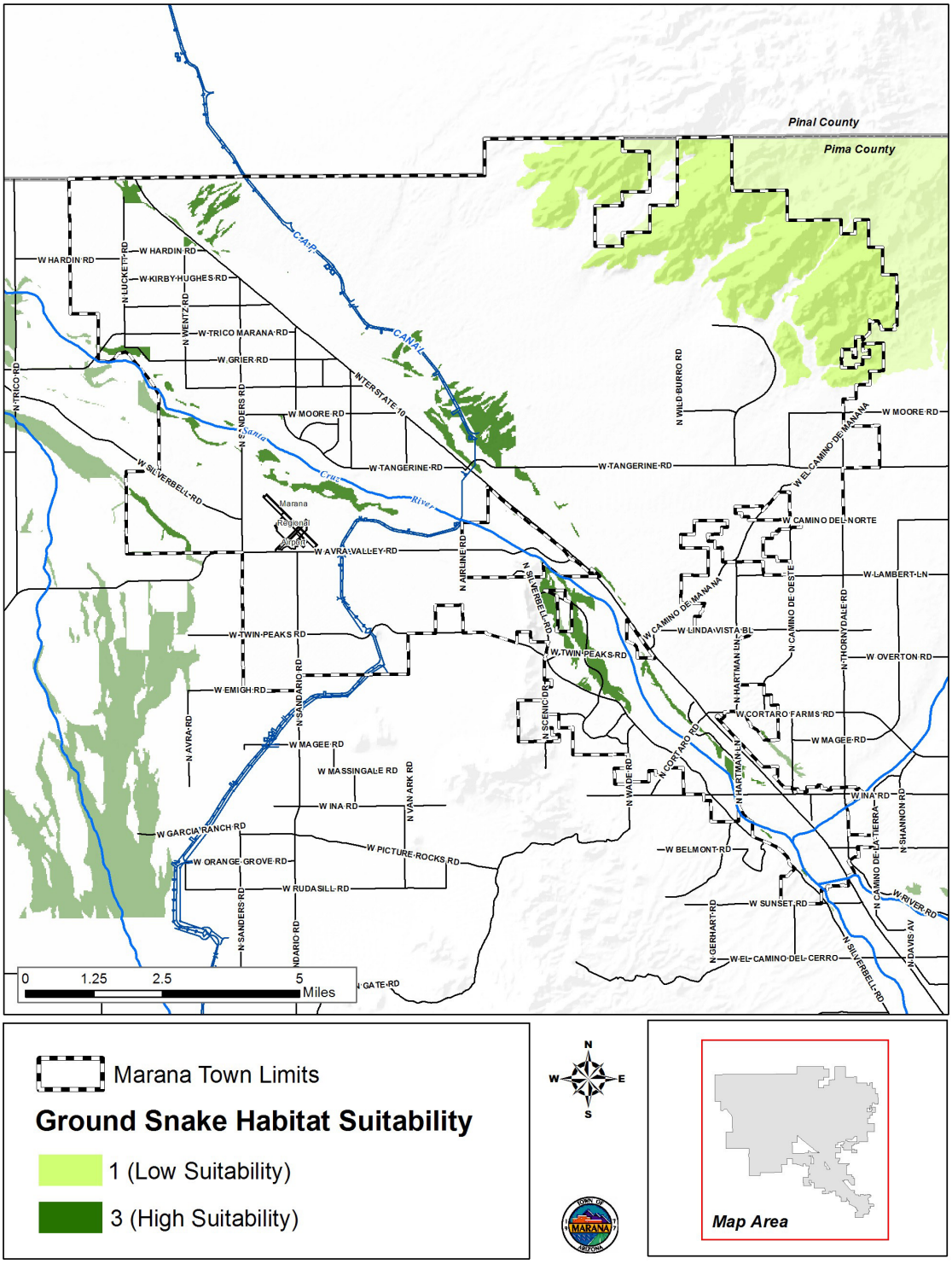

FIGURE 4.4-3
Habitat suitability model for the Ground Snake (*Sonora semiannulata*) in eastern Pima County, Arizona, based on soil type determined from pre-2003 records. The large potentially suitable area toward lower left is Brawley Wash bottom south of Avra Valley Road; the small potential site is north of the Santa Cruz River at Sanders Road. (Rosen 2004)

Relation to Species' Range and Ecology

The Town and vicinity represent a small and likely inconsequential portion of this widely distributed species' range (i.e., much of the western United States and north-central Mexico). The range of the "valley form" of the ground snake under consideration here extends north to Eloy and is likely most abundant around Red Rock (Figure 4.4-1). Relative to the rest of Pima County the potential habitat within the Town represents less than 3 percent of the estimated 1,417,358 acres of potential habitat in the County. Figure 4.4-3 illustrates the relatively larger tracts of potential habitat west and south of the Town's boundary.

4.4.3 Potential Impacts of Town's Proposed Activities

Direct Effects

Urban development has the potential to directly and indirectly harm the ground snake. If construction occurs during the winter, construction activities can cause mortality or injury to snakes that are likely to be in underground dens during that time of year. During the summer, when snakes are active, they can be vulnerable to direct mortality and injury from construction equipment. Snakes that are displaced by urban development could experience higher mortality while searching for suitable, unoccupied habitat. Construction associated with road improvement projects could result in mortality or injury to snakes through similar means.

Indirect Effects

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

Changes in Habitat

Based on the Town of Marana's General Plan, a total of 6,415 acres of potential habitat for ground snakes would be developed over the next 25 years. Of this acreage, 5,269 acres would be in areas planned for low-density development, and 1,136 acres would be in areas of high-density development. An additional 10 acres would be impacted by road construction. Suitable habitat could remain in some portions of the areas proposed for development; particularly parks, schools, and other areas left as open space. Under the proposed development, 3,934 acres of potential habitat for ground snakes would remain in the Town. Conversion of existing undeveloped habitat to urban development is likely to have an adverse effect on the habitats' ability to support the species but the effect of converting agricultural lands to urban developments on this species habitat is unclear. Agricultural fields do not currently provide suitable soil conditions for ground snakes, however, farm homes, sheds, 'bone' yards and other areas associated with agricultural operations could support ground snakes. As such, loss of these areas to urban development could represent a loss of habitat for the ground snake.

Population Effects

The potential effect of covered activities on the ground snake's valley form population is uncertain because the current distribution and abundance of the species in the planning area is unknown. In the Phoenix area the species is known to persist in urban and modified environments and, in New Mexico, the species has been reported to tolerate or benefit from human developments including farm outbuildings (barns, silos, and sheds), and abandoned buildings (BISON-M 2000 *in* RECON 2002). Based on these observations, ground snakes could persist in portions of the Town following urban development. However, no specific information is available on the valley form of this species with respect to its tolerance to human development and activity (RECON 2002).

4.4.4 Biological Goals and Objectives

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

- Continue to support ground snakes within the Town limits.

The Town's specific objective is to:

- Maintain the suitability of habitat for ground snakes in the Town

4.4.5 Conservation Measures

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

Habitat for the ground snake that occurs in the Santa Cruz River floodway will be protected with implementation of the Burrowing Owl Conservation Strategy. The two cactus ferruginous pygmy-owl conservation strategies include retention of habitat for pygmy-owls in the Tortolita Mountains which will result in retention of habitat for ground snake as well. These two strategies would ensure retention of habitat for ground snakes in two of the three primary areas of the Town that contains suitable habitat for the snake. Conservation measures specific to the ground snake will be implemented to retain suitable habitat in the third area between I-10 and the CAP canal. The following summarizes the components of the two pygmy owl conservation strategies and the burrowing owls conservation strategy that will benefit ground snakes and details conservation measures specific to the ground snake. The complete text of these measures is provided in the *Section 4.3 Burrowing Owl* and *Section 4.2 Cactus Ferruginous Pygmy-owl*.

Burrowing Owl Conservation Strategy

- The Town will prohibit, to the extent possible, development within the floodway of the Santa Cruz River. The Town will discourage those activities within the floodplain which are allowable under current zoning or permitting processes and which, if prohibited, could constitute a taking of property (Burrowing Owl Measure – 1).

Cactus Ferruginous Pygmy-Owl Conservation Strategy

Strategy A – Section 7-based Approach

- The Town will through ordinance or some other appropriate and legally binding mechanism
  - Limit surface disturbance to 30 to 60 percent in the area north of Cortaro Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of the eastern Town boundary
  - Disturbance to protected desert vegetation will be minimized
  - Use of non-native or invasive plant species as landscaping will be minimized (Pygmy-owl Measure - A1).
- The Town will establish three pygmy-owl conservation zones in the Town with development restrictions as follows
  - Zone 1: Surface disturbance will be limited to 20 to 30 percent maximum disturbance[1].
  - Zone 2: Surface disturbance will be limited to 40 percent maximum disturbance[1].
  - Zone 3: Corridors will be preserved by establishing a 300-foot buffer along washes with a 100-year discharge greater than 500 cfs (Pygmy-owl Measure - A2).

Strategy B – Augmentation Approach

- The Town will acquire State Trust Lands in the Tortolita fan to set aside as a permanent preserve with 18,600 acres of habitat for the cactus ferruginous pygmy-owl. The preserve will roughly consist of all State Trust Land beginning 3,600 feet north of Tangerine Road, and from the CAP canal east to the Town boundary (Pygmy-owl Measure - B1).
- The Town will, by ordinance or some other appropriate and legally binding mechanism:
  - Limit surface disturbance to 30 to 60 percent in the area north of Magee Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of a line corresponding to the Shannon Road alignment
  - Minimize disturbance to protected desert vegetation

[1] Under certain specified conditions surface disturbance can be greater than 30% in Zone 1 and greater than 40% in Zone 2. See Pygmy Owl Measure A2 in Section 4.2 Cactus Ferruginous Pygmy-Owl for the full text of the measure.

- Minimize use of non-native or invasive plant species as landscaping (Pygmy-owl Measure - B3).

- The Town will preserve corridors between the preserve and habitat to the south of the preserve. These corridors will, at a minimum, consist of five 300-meter (984-foot) wide corridors centered on the five largest washes crossing Tangerine Road (Pygmy-owl Measure – B4).
- The Town will preserve dispersal corridors across Interstate-10 by requiring establishment of 300-foot buffer along washes with a 100-year discharge greater than 500 cfs (Pygmy-owl Measure – B5).

Ground Snake Measure – 1. *The Town will develop and impose development guidelines to ensure open space suitable to support ground snakes is provided for and maintained on lands situated between U.S. Interstate – 10 and the Central Arizona Project canal.*

At a minimum the guidelines will require landscaping of planned open space, such as gardens and water detention basins, within urban areas; to provide areas where soil and vegetative conditions are suitable to support ground snakes. These areas will be managed and maintained to retain the appropriate habitat conditions (i.e., soils, vegetation, artificial and natural cover) for ground snakes.

The Town's environmental planner will enforce guidelines through development review.

Ground Snake Measure – 2. *The Town will support creation of the Marana Mounds Archaeological Site by Pima County in recognition of its value as ground snake habitat as well as its cultural resources.*

4.4.6 Monitoring and Adaptive Management Program

Monitoring the effectiveness of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its 5-Point Policy Guidance (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

1. *Compliance monitoring* – Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.
2. *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring.

Compliance Monitoring and Reporting

Compliance monitoring and reporting will be accomplished through submittal of annual reports documenting progress toward and completion of the conservation commitments. The Town will submit annual reports to the USFWS that describe the activities permitted or implemented by the Town in the previous year in the area between I-10 and the C.A.P. canal and in modeled suitable habitat in the Tortolita Mountains. The report will include the amount of undisturbed open space and disturbed but revegetated open space within each project area.

Effectiveness Monitoring and Reporting

Effectiveness monitoring addresses whether the conservation measures are achieving the biological goals and objectives. For ground snakes, effectiveness monitoring and adaptive management is not necessary or useful in this HCP. The biological goal for ground snakes is to contribute to maintaining snakes within the Town. Whether ground snakes do or will continue to reside in the Town depends on many factors beyond the impact of covered activities on habitat within the Town, including regional population size, dispersal characteristics, and climatic conditions. As these additional factors are outside of the Town's control and the local population size is small, it would not be possible to determine if a lack of use of habitats in the Town by ground snakes was because of habitat conditions in the Town that result from permitted activities or conditions beyond the Town's control.

On-Going Monitoring and Adaptive Management

The Town will monitor development in potential ground snake habitat between Interstate - 10 and the CAP canal and in the Tortolita Mountains in order to evaluate compliance with the guidelines and the CFPO conservation measures. The Town will meet with the USFWS and other ground snake experts every 5 years for the term of the permit to review and discuss any new information about the ground snake, in particular the snake's habitat requirements, and if warranted, modify the development guidelines to reflect this new information.

4.4.7 Effects of Implementing the HCP on Ground Snakes

Although there are currently an estimated 10,349 acres of suitable habitat in the Town, existing information indicates that very few ground snakes inhabit the Town. The Town's conservation approach for this species is to preserve and protect snake habitat within the Town. This approach will be effective in allowing the ground snake to survive and possibly increase in the Town. However, the Town represents less than 3 percent of the estimated 1,417,358 acres of potential habitat in the County. As Figure 4.4-3 illustrates, relatively larger tracts of potential habitat occur west and south of the Town's boundary. Clearly, the long-term persistence of this form of the ground snake is dependent on conservation measures being undertaken by other jurisdictions. Nonetheless, the Town will contribute to the long-term survival of ground snakes by retaining suitable habitat for the snake in the Town.

West of U.S. Interstate-10, about 527 acres of suitable habitat would be protected within the Santa Cruz River floodway while 1,293 acres of relatively small and isolated patches of habitat situated in agricultural areas would be subject to development.

The level of development in ground snake habitat east of the CAP is contingent on whether the Town's objective of establishing an 18,900-acre preserve is meet. Whether the preserve is established or not, the ground snake habitat would be protected through establishment of limits on allowable surface disturbance (CFPO Measure A2). Under CFPO Strategy A, Measure A2 would protect 4,824 acres of ground snake habitat primarily located on gravelly soils at the base of the Tortolita Mountains. An additional 527 acres would be protected within the Santa Cruz River floodway. In total, 52 percent of the Town's potential ground snake habitat would be protected under CFPO Strategy A and the Burrowing Owl conservation strategy.

CFPO Strategy B would result in the establishment of a large preserve, of which 5,488 acres is ground snake habitat. With the institution of surface disturbance limits (CFPO Measure B3) and creation of the habitat preserve (CFPO Measure B1), under Strategy B 6,966 acres of potential habitat for ground snakes would be protected at the base of the Tortolita Mountains. As is the case with all alternatives, 527 acres of habitat would be protected within the Santa Cruz River floodway. In total, 72 percent of the Town's potential ground snake habitat would be placed under protection. Proposed development within the Tortolita Mountains will be low to very-low density and, according to Dr. Phil Rosen, does not impair the ability of this habitat to support ground snakes.

Further habitat protection would be provided to ground snakes by the Town's open space guidelines and protection of the Marana Mounds on lands situated between U.S. Interstate–10 and the CAP.

4.5 Tucson Shovel-Nosed Snake (*CHIONACTIS OCCIPITALIS KLAUBERI*)

4.5.1 Population Status and Ecology

Range and Distribution

The range of the western shovel-nosed snake (*Chionactis occipitalis*) encompasses most of the Mohave and Sonoran desert region of the southwestern U.S. and a small portion of contiguous Mexico. This species' range extends from below sea level to about 4,700 feet (1,430 meters) (Stebbins 1985). In Arizona it is associated with valley floors below 2,000 feet (610 meters) (Lowe 1964). Rosen (2003b) described shovel-nosed snakes as being abundant in the great dunes of the Gran Desierto, Lower Colorado Valley, and Mohave Desert.

The taxonomy of the western shovel-nosed snake is not well known. Four subspecies have been described and it appears likely that smaller genetic units may constitute valid subspecific taxa (Rosen 2003b). The Tucson shovel-nosed snake's (*C. o. klauberi*) historical range has been described as extending in a narrow band from southeastern Maricopa County through southwestern Pinal County to northern Pima County inclusive of the Town (RECON 2002). As currently mapped, this range encompasses the margin of the Arizona Upland subdivision of the Sonoran Desert including portions of Scottsdale, Florence, Casa Grande, Avra Valley, and the Town of Marana (Rosen 2003b). Snakes with characteristics considered intermediate between Colorado Desert shovel-nosed snakes (*C. o. annulata*) and Tucson shovel-nosed snake may occupy the northeastern edge of the Tohono O'odham Nation, Sonoran Desert National Monument near Mobile, and in the vicinity of Ajo (Rosen 2003b).

Population Status and Threats

Loss of habitat has been the primary threat identified for this subspecies' presumed decline, both through agricultural and urban development. Grading former habitat alters soil conditions thereby eliminating an essential habitat component for this species. Rosen (2003b) concluded that the Tucson shovel-nosed snake population has severely declined in the Avra Valley including that portion in Marana since the 1960's and 1970's and may now have been extirpated from the area. However, Rosen (2004) reported a Tucson shovel-nosed snake was observed near Picacho in 2004, the first regional record since 1979.

Rosen (2003a) speculates that urban expansion and agricultural development have severely impacted or extirpated populations in that area of Scottsdale, Florence, and Casa Grande. Identified threats include:

- Agriculture development
- Urban development
- New road construction
- Increased traffic on new and existing roads
- Off road vehicle activity, and
- Possibly, scientific and commercial collection of the subspecies.

Life History

The shovel-nosed snake is adapted to move quickly through loose sand and loam. This movement has been described as sand swimming (Stebbins 1985, Rosen 2003b). They are small snakes that use venom to subdue their prey but are harmless to humans (Rosen 2003b). Their prey includes insects, scorpions, spiders and centipedes (Stebbins 1985, Rosen 2003b). The species is oviparous and has a clutch of 2 to 4 eggs in the summer (Stebbins 1985).

Western shovel-nosed snakes are primarily nocturnal (Stebbins 1985) although on cool days they may also be active in the late and early evening (Warren 1953 *in* RECON 2002). Rosen (2003b) researched the seasonal activity cycle of the Tucson shovel-nosed snake as part of a recent survey effort. Activity peaks during May with rapidly decreasing activity through late June. There is residual activity in early July and almost no observed activity after that.

Habitat Requirements

The western shovel-nosed snake is known from the Lower Sonoran life zone primarily on valley bottoms with sand dunes or soft sandy loams. In Marana, this means the shovel-nosed snake is (or was) to be found on sandier soils on the lowermost bajadas or possibly on sandy areas deposited by the large arroyos or in parts of the Santa Cruz River (Rosen 2003a).

4.5.2 Existing Conditions

Population in and Near the Town

The last record of the Tucson shovel-nosed snake in the vicinity of the Town was at Sanders Road and Avra Valley Road in 1982. It is unknown whether the species persists within the Town boundaries. It was not observed during recent (2003), focused surveys. However, these surveys were initiated during the latter half of the seasonal activity cycle after most of the year's activity had occurred (Rosen 2003b). A Tucson shovel-nosed snake was observed near Picacho in 2004, the first regional record since 1979, showing that the species is not regionally extinct, and may still inhabit the Avra Valley (Rosen 2004).

Habitat in and Near the Town

Rosen (2003b) identified suitable habitat for the Tucson shovel-nosed snake in or near the Town as remaining in the Avra Valley, including portions of the Town. Areas of potential habitat include:

> "… around the airport; north of Twin Peaks Road between Tucson Mountains and Sanders Road; northwest of Avra Valley Road and Sanders Road between Silverbell Road and the agricultural fields southwest of the Brawley Wash diversion channel; and the large area south of Avra Valley Road to about 2 miles south of the Magee Road alignment, from Pump Station and Anway Roads east across the Brawley flats to Avra Road or Sander Road." (Rosen 2003b)

Potential habitat for the Tucson shovel-nosed snake was modeled using methods developed as part of the Sonoran Desert Conservation Plan (RECON 2002). The habitat model, developed by Dr. Phil Rosen, consisted of three primary variables: 1) land use, 2) elevation, and 3) soils. The habitat value of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provide no habitat value and 3 indicating that the

category provided high habitat value. The three variables were combined to provide an overall habitat value (Table 4.5-1).

TABLE 4.5-1
Revised SDCP model for Tucson shovel-nosed snake. Value rating recommended by Dr. Phil Rosen.

Variable/Category	Value Rating
LAND USE	
Developed areas	Mask
Active agriculture	Mask
ELEVATION	
< 640 meters	3
640 – 670 meters	2
670 – 700 meters	1
> 700 meters	Mask
SOILS	
Sandy loam	3
Sandy clay loam	3
Clay loam	3
Loam (except Gila loam)	3
Gila loam	2
Silty clay loam	2
Clay	1
Gravelly loam	2

Dr. Rosen concluded that soils provided the best and most logical predictor of habitat for Tucson shovel-nosed snakes. Higher elevations (greater than 700 meters or about 2,300 feet),) were masked as the species records indicate that the higher areas cannot support the species. Agricultural lands were masked because soils conditions have been modified to an extent that they could not support this species. Developed areas also were masked because these areas do not provide suitable soils for shovel-nosed snakes.

Landform, as used in the SDCP model, did not appear to be important other than as a predictor of soil conditions. Other than Creosotebush (*Larrea tridentata*)-Bursage (*Ambrosia dumosa*), vegetation also was determined to be a poor predictor relative to soil type. After looking at habitat model results based on soils, elevation, and vegetation, Dr. Rosen concluded that the use of vegetation resulted in an inaccurate emphasis on areas with less potential for snakes and de-emphasized areas of higher quality habitat. Vegetation was therefore omitted from the habitat model. The output of the habitat suitability model for the Tucson shovel-nosed snake is shown in Figure 4.5-1.

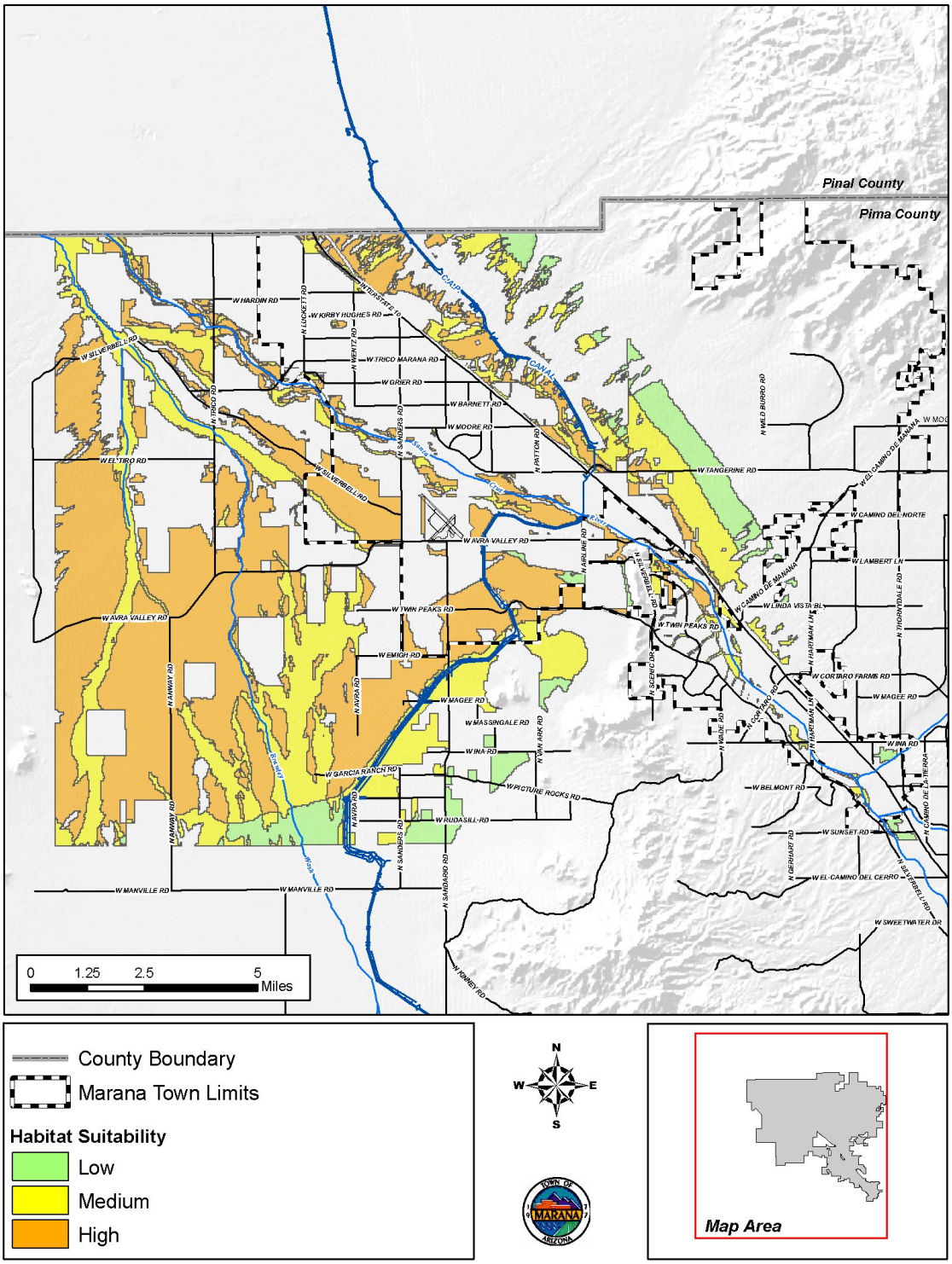

FIGURE 4.5-1

Potential suitable habitat for the Tucson shovel-nosed snake in the Town of Marana.

Relation to Species' Range and Ecology

The Town and vicinity represent a small and likely inconsequential portion of this widely distributed species' range (i.e., most of the Mohave and Sonoran deserts). The range of the subspecies under consideration here extends from southeastern Maricopa County through southwestern Pinal County to northern Pima County, inclusive of the Town. Relative to the rest of Pima County the potential habitat within the Town represents less than 3 percent of the estimated 334,703 acres of potential habitat in the County. Figure 4.5-1 illustrates the relatively larger tracts of potential habitat west and south of the Town's boundary. It is possible that the Tucson shovel-nosed snake genotype might only be available for long-term conservation in the area of Mobile, Arizona (Rosen 2003b).

4.5.3 Potential Impacts of Town's Proposed Activities

Direct Effects

Urban development has the potential to directly and indirectly harm the snake if it is still present. Construction activities can cause mortality or injury to snakes. Snakes that are displaced by construction activities could experience higher mortality while searching for suitable, unoccupied habitat. Construction associated with road improvement projects could result in mortality or injury to snakes through similar means.

Indirect Effects

In addition, roads and increased traffic on road can increase mortality of snakes from vehicle strikes. Over the longer term, conversion of suitable habitat to urban uses could result in take of snakes through a variety of mechanisms, including reduced foraging opportunities, reduced or degraded denning opportunities, and increased predation associated with urban development.

Changes in Habitat

Based on the Town of Marana's General Plan, a total of 13,712 acres of potential habitat for the Tucson shovel-nosed snake would be developed over the next 25 years. Of this acreage, 4,996 acres would be in areas planned for low-density development, and 8,633 acres would be in areas of high-density development. An additional 83 acres would be impacted by road construction. Under the proposed development, 1,914 acres of potential habitat (12 percent of the exiting total) for shovel-nosed snakes would remain in the Town. Once suitable habitat with relatively undisturbed soil conditions is graded for development its potential value to this species is lost.

Population Effects

Because it is not known whether this species persists in the Town, the population effects of the Town's proposed activities are unknown.

4.5.4 Biological Goals and Objectives

The Town's biological goal for the Tucson shovel-nosed snake is to

- Contribute to maintaining local and regional populations of the Tucson shovel-nosed snake.

The Town's specific objective is to:

- Conserve suitable Tucson shovel-nosed snake habitat.

4.5.5 Conservation Measures

Developing a conservation strategy for the Tucson shovel-nosed snake is complicated by lack of recent records of the snake in the Town. At present, there have been no detections in Marana since 1979. A recent observation of a Tucson shovel-nosed snake in June 2004 is from the Picacho area in Pinal County (Rosen 2004). If the species still inhabits Marana, then it would be important to preserve remaining patches of remaining creosote bush and creosote bush-mesquite upland desertscrub plant associations, much of which occurs on State Trust Lands, or to mitigate the loss of habitat with the acquisition of suitable habitat elsewhere.

The lack of recent records of the shovel-nosed snake in Marana adds an element of uncertainty into the planning process. One approach (Strategy A) is for the Town to assume that the snake still inhabits suitable habitat in the Town and to mitigate the loss of suitable habitat from development by protecting habitat for the snake outside of the Town. This mitigation approach could be accomplished by imposing a mitigation fee on development in suitable habitat for the snake which the Town then would use to acquire mitigation lands.. This approach would require all developers to pay a fee and the Town mitigate impacts to habitat, but would not address the issue of whether the snake is actually present within Marana or not. In this scenario, the overall cost of mitigation would be spread evenly across all developers that impact suitable snake habitat.

A second approach (Strategy B) would defer the imposition of mitigation requirements until a snake is actually found. In this approach, the Town would conduct intensive surveys for the snake and, if a snake is found, the Town would require individual developers to mitigate development in suitable shovel-nosed snake habitat in the Town by purchasing mitigation lands outside of the Town according to pre-specified mitigation ratios. The overall cost of mitigation would be shifted to those developers whose projects are implemented after a snake is found within the Town. If no snakes are ever found to be present within the permit period, no mitigation will be imposed on developers. These two approaches are detailed below.

4.5.6 Strategy A – Town-driven Mitigation Approach

Shovel-nosed Snake Measure – A1. *The Town will mitigate the loss of suitable shovel-nosed snake habitat that is located in the Town and west of Interstate-10 due to development by acquiring suitable habitat in Pima County west of Marana (Figure 4.5-2) or in and around the Picacho, Florence, or Mobile areas in Pinal and Maricopa Counties (Figure 4.5-3) either through direct purchase or purchase of development rights. The mitigation land for the shovel-nosed snake may also be acquired in cooperation with Pima County, the City of Tucson, or other local jurisdictions. The Town will conduct an assessment of the habitat suitability of proposed mitigation parcel(s) as a basis for selecting mitigation lands. Habitat suitability will be determined through use of the Town of Marana's Tucson shovel-nosed snake habitat suitability model in concert with a site survey. For every acre impacted by development, the Town will acquire mitigation lands in accordance with the mitigation ratios shown below in Table 4.5-2. The Town will obtain written approval from the*

USFWS on the mitigation area to be acquired. The Town will ensure the long-term conservation of the management areas through obtaining a conservation easement or another mechanism approved by the USFWS. The Town will develop a management plan for all mitigation lands within 1 year of acquisition of those lands.

The Town may purchase mitigation lands in phases to match the rate of development within suitable snake habitat within the Town subject to the following constraints.

- *Sufficient land will be purchased within 5 years of the permit issuance to mitigate for 75% of development occurring within those 5 years.*
- *Additional purchases of land can also be phased to mitigate actual levels of development so long as the land required to mitigate any single development is purchased within 5 years of the initiation of construction for that development.*

TABLE 4.5-2
Ratios for mitigating impacts to suitable habitat for Tucson shovel-nosed snakes under Strategy A

Mitigation Location[a]	Habitat suitability rating[b]	Contiguous[c]	Mitigation Ratio
Picacho/Florence	9-6	Yes	1:1
Picacho/Florence	5	Yes	1:1
Picacho/Florence	9-6	No	1:1
Picacho/Florence	5	No	2:1
Pima County	9-6	Yes	1:1
Pima County	5	Yes	2:1
Pima County	9-6	No	2:1
Pima County	5	No	4:1
Mobile	9-6	Yes	2:1
Mobile	5	Yes	4:1
Mobile	9-6	No	4:1
Mobile	5	No	8:1

[a] Mitigation locations refers to which of 2 general areas have been identified locations for suitable mitigation parcels.

[b] The rating is the score that a property receives based on the Town of Marana's Tucson shovel-nosed snake habitat model.

[c] Contiguous refers to whether or not a mitigation property is contiguous with lands with some form of existing, permanent conservation protections.

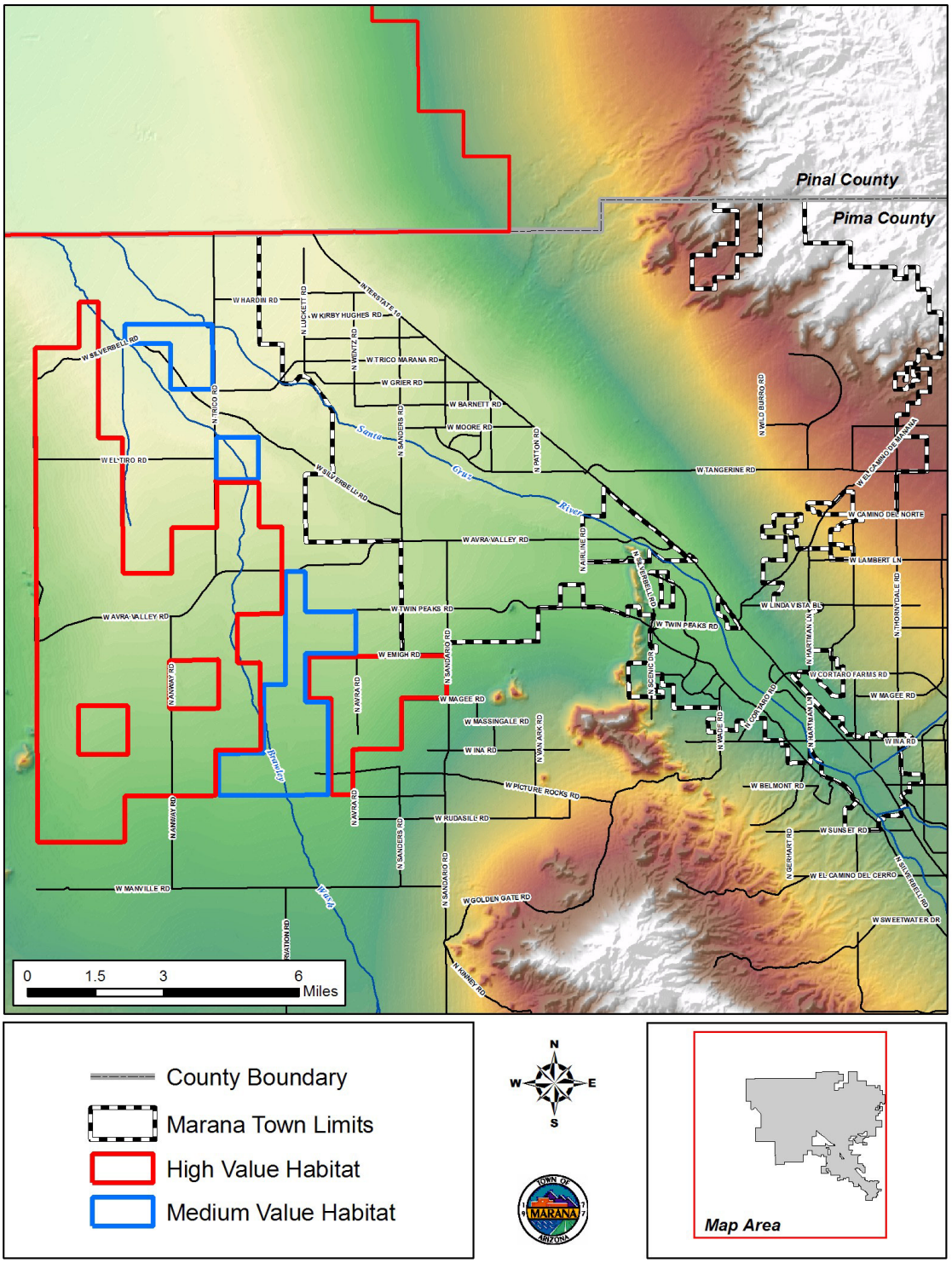

FIGURE 4.5-2
Potential areas for acquiring mitigation lands for Tucson shovel-nosed snakes in Pima County.

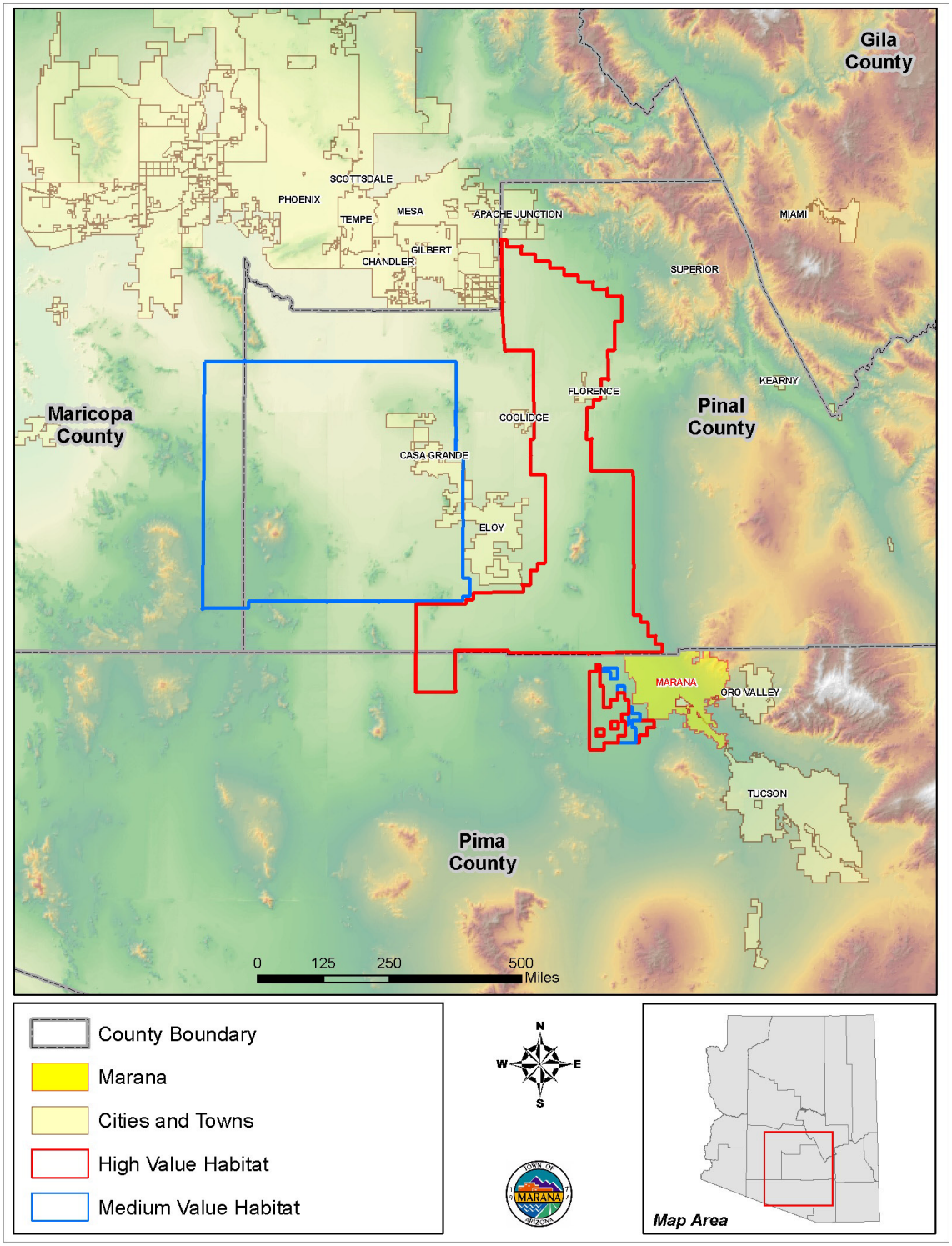

FIGURE 4.5-3
Potential areas for acquiring mitigation lands for Tucson shovel-nosed snakes in Pinal and Mariposa Counties.

4.5.7 Town-driven Mitigation Approach Monitoring and Adaptive Management Program

Monitoring the effectiveness of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its 5-Point Policy Guidance (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

1. *Compliance monitoring* – Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.
2. *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring.

Compliance Monitoring and Reporting

Compliance monitoring and reporting will be accomplished through submittal of annual reports documenting progress toward and completion of the conservation commitments.

1. The Town will submit annual reports to the USFWS that include the following information:

- Activities permitted or implemented by the Town within suitable shovel-nosed snake habitat during the preceding year
- Status of land acquisition for mitigation
- Activities undertaken to enforce restrictions on use of the mitigation lands as specified in the management plan for these properties

2. Upon acquisition of mitigation land, the Town will demonstrate to the USFWS proof of ownership or proof of establishment of a conservation easement for the land.
3. The Town will provide copies of management plans to the USFWS.

Effectiveness Monitoring and Adaptive Management

Effectiveness monitoring addresses whether the conservation measures are achieving the biological goals and objectives. The biological goal for the Tucson shovel-nosed snake is to contribute to maintaining local and regional populations. This goal is to be accomplished by the Town purchasing and conserving suitable habitat for the snake. Mitigation lands will be suitable for the snake in terms of key habitat variables (soil, vegetation community, and elevation) and located in areas known or suspected to be occupied by the snake. Whether Tucson shovel-nosed snakes will persist on the mitigation lands will depend on many factors most of which are beyond the Town's ability to influence, including the regional population size, dispersal capabilities of the snake, and climatic conditions. As the local population size is certainly small, and the species may even be locally extinct, it may not be

possible to determine if shovel-nosed snakes are using the mitigation properties, much less gather sufficient data to evaluate population trends during the permit period. Because the shovel-nosed snake cannot be reliably detected in surveys, and the key variables influencing habitat suitability for the snake (soil characteristics, vegetation community, and elevation) cannot be effectively manipulated, a monitoring and adaptive management program based on snake surveys and habitat assessments would not improve the effectiveness of the conservation strategy for the Tucson shovel-nosed snake. Aside from preventing unauthorized use of the mitigation properties and ensuring that violations are quickly rectified, there is little the Town can do to alter the suitability of habitat for shovel-nosed snakes on the properties. Thus, adaptive management will be restricted to changes in the management plan for the mitigation areas, specifically with respect to patrol and enforcement of use restrictions.

4.5.8 Strategy B – Developer-driven Mitigation Approach

Shovel-nosed Snake Measure – B1. *The Town will conduct intensive annual surveys of suitable shovel-nosed snake habitat that is in the Town and west of Interstate-10. The surveys will be conducted for 5 years. The most recent habitat model developed by Dr. Phil Rosen for this HCP will used to define areas of suitable habitat.*

Shovel-nosed Snake Measure – B2. *The Town will limit the amount of development permitted on State Trust Lands that contain suitable habitat for the shovel-nosed snake during the 5-year survey period outlined in Measure - B1.*

The Town will restrict development approvals according to the following guidelines:

- *No development will be permitted on State Trust Lands within the first 2 years following permit issuance, except in areas without suitable shovel-nosed snake habitat*
- *The Town will not permit more than 5% of State Trust lands with suitable shovel-nosed snake habitat to be developed in years 3 through 5 following permit issuance.*
- *After year 5, if no shovel-nosed snakes have been found in Marana, there will be no further development restrictions on areas of potential shovel-nosed snake habitat except as provided for in Measure – B3.*

Shovel-nosed Snake Measure – B3. *If, at any time within the permit period, shovel-nosed snakes are found in the Town, the Town will require proponents of all future developments in suitable shovel-nosed snake habitat in the Town that is west of Interstate-10 to mitigate the loss of habitat by acquiring suitable habitat in Pima County west of Marana (Figure 4.5-2) or in and around the Picacho, Florence, or Mobile areas in Pinal and Maricopa Counties (Figure 4.5-3). Only future developments within the same block of habitat (Figure 4.5-4) will be required to mitigate for the presence of a snake in that block. Blocks of habitat were identified based on the presence of barriers to snake movement. The Town will require project proponents to conduct an assessment of the habitat suitability of proposed mitigation parcel(s) as a basis for selecting mitigation lands. Habitat suitability will be determined through use of the Town of Marana's Tucson shovel-nosed snake habitat suitability model in concert with a site survey. For every acre impacted by development, the developer will acquire mitigation lands in accordance with the mitigation ratios shown in Table 4.5-3. The developer will obtain written approval from the USFWS on the mitigation area to be acquired and will ensure the long-term conservation of the management areas through obtaining a*

conservation easement or another mechanism approved by the USFWS. The developer will develop a management plan for all mitigation lands within 1 year of acquisition of those lands.

TABLE 4.5-3
Ratios for mitigation impacts to suitable habitat for Tucson shovel-nosed snakes under Strategy B

Mitigation Location[a]	Habitat suitability rating[b]	Contiguous[c]	Mitigation Ratio
Picacho/Florence	9-6	Yes	1:1
Picacho/Florence	5	Yes	2:1
Picacho/Florence	9-6	No	2:1
Picacho/Florence	5	No	4:1
Pima County	9-6	Yes	2:1
Pima County	5	Yes	4:1
Pima County	9-6	No	4:1
Pima County	5	No	8:1
Mobile	9-6	Yes	2:1
Mobile	5	Yes	4:1
Mobile	9-6	No	4:1
Mobile	5	No	8:1

[a] Mitigation locations refers to which of 2 general areas have been identified locations for suitable mitigation parcels.

[b] The rating is the score that a property receives based on the Town of Marana's Tucson shovel-nosed snake habitat model.

[c] Contiguous refers to whether or not a mitigation property is contiguous with lands with some form of existing, permanent conservation protections.

4.5.9 Developer-driven Mitigation Approach Monitoring and Adaptive Management Program

Monitoring the effectiveness of the conservation measures and ensuring compliance with the terms of the conservation program are mandatory elements of an HCP. The USFWS elaborated on monitoring and adaptive management requirements for HCPs in its 5-Point Policy Guidance (64 FR 11485). The USFWS identifies two types of monitoring required for HCPs:

1. *Compliance monitoring* – Monitoring and reporting requirements necessary to demonstrate that HCP requirements are being carried out.

2. *Effectiveness monitoring* – Monitoring and reporting requirements necessary to evaluate whether the HCP measures are achieving the biological goals and objectives. Effectiveness monitoring also provides information to support adaptive management decisions.

The following describes monitoring and reporting requirements for compliance and effectiveness monitoring.

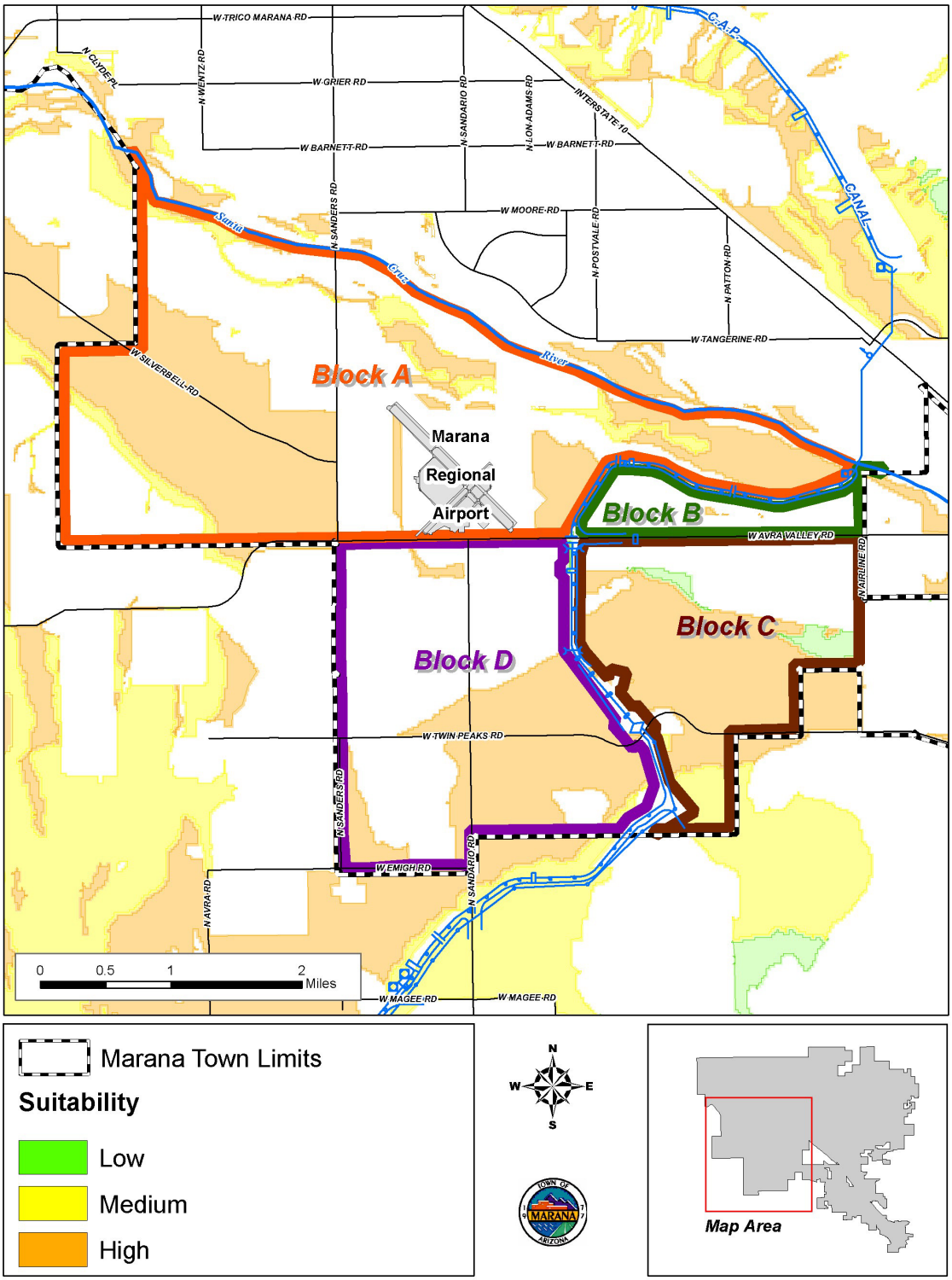

FIGURE 4.5-4
Tucson shovel-nosed snake habitat blocks within the Town of Marana

Compliance Monitoring and Reporting

Compliance monitoring and reporting will be accomplished through submittal of annual reports documenting progress toward and completion of the conservation commitments.

1. The Town will submit annual reports to the USFWS that

- describes the activities permitted or implemented by the Town within suitable shovel-nosed snake habitat during the preceding year
- presents the results of the intensive surveys for the Tucson shovel-nosed snake.

2. Upon acquisition of mitigation land, the Town will ensure that the developer demonstrates to the USFWS proof of ownership or proof of establishment of a conservation easement for the land.
3. The Town will ensure that the developer provides provide copies of management plans to the USFWS.

Effectiveness Monitoring and Reporting

Effectiveness monitoring addresses whether the conservation measures are achieving the biological goals and objectives. The biological goal for the Tucson shovel-nosed snake is to contribute to maintaining local and regional populations. This goal is to be accomplished by the Town conducting intensive surveys for the snake and requiring developers to mitigate impacts to suitable habitat if the snake is found in the Town. This strategy is inherently adaptive in that it adjusts the mitigation program in response to new information on the occurrence of the snake.

If Tucson shovel-nosed snakes are found, then mitigation lands will be acquired to compensate for impacts to suitable habitat in the Town from development. Mitigation lands will be suitable for the snake in terms of key habitat variables (soil, vegetation community, and elevation) and located in areas known or suspected to be occupied by the snake. Whether Tucson shovel-nosed snakes will persist on the mitigation lands will depend on many factors most of which cannot be influenced by management of the mitigation lands, including the regional population size, dispersal capabilities of the snake, and climatic conditions. As the local population size is certainly small and the species may even be locally extinct, it may not be possible to determine if shovel-nosed snakes are using the mitigation properties, much less gather sufficient data to evaluate population trends during the permit period. Because the shovel-nosed snake cannot be reliably detected in surveys, and the key variables influencing habitat suitability for the snake (soil characteristics, vegetation community, and elevation) cannot be effectively manipulated, a monitoring and adaptive management program based on snake surveys and habitat assessments would not improve the effectiveness of the conservation strategy for the Tucson shovel-nosed snake. Aside from preventing unauthorized use of the mitigation properties and ensuring that violations are quickly rectified, there is little that can be done to alter the suitability of habitat for shovel-nosed snakes on the properties. Thus, if acquisition of mitigation lands is required, adaptive management will be restricted to changes in the management plan for the mitigation areas, specifically with respect to patrol and enforcement of use restrictions.

4.5.10 Effects of Implementing the HCP on Tucson Shovel-nosed Snakes

Strategy A – Town-driven Mitigation Approach

The Town's goal is to contribute to maintaining local and regional populations of the Tucson shovel-nosed snake. This goal is to be accomplished through acquiring and protecting suitable habitat for this species within its current range. The Town's strategy recognizes that the Town has a small area of suitable habitat relative to other jurisdictions and it is questionable whether the species still inhabits habitat in the Town. This subspecies' ability to persist is dependent on conservation measure taken on larger tracts of habitat in Pima County west of the Town and in the Picacho, Florence, and Mobile areas in Pinal and Maricopa counties. In light of this circumstance, the Town's conservation strategy is to mitigate the loss of suitable habitat from development by protecting habitat for the snake outside of the Town in areas of higher quality habitat and where the snake is believed to still persist. This strategy would result in the acquisition and protection of important suitable habitat that is, where possible, contiguous with other lands receiving protection. The net result over the life of the HCP permit would be more suitable habitat receiving protection regionally than would occur if the HCP were not implemented. As a result, implementing the HCP would enhance the shovel-nosed snake's ability to persist or even recover within the region.

Strategy B – Developer-driven Mitigation Approach

The Town's goal is to contribute to maintaining local and regional populations of the Tucson shovel-nosed snake. This goal is to be accomplished through conserving suitable habitat for this species within its range should the species be determined to be present within the Town. The Town's strategy recognizes that the Town has a small area of suitable habitat relative to other jurisdictions and that the subspecies could be locally extinct.

Intensive annual surveys within the Town will contribute to an understanding of status of the species, particularly whether it is locally extinct. Measures to restrict development in suitable habitat during the 5-year survey period would be effective in ensuring minimal unmitigated habitat loss. This subspecies ability to persist is dependent on conservation measures taken for larger tracts of habitat in Pima County west of the Town and in the Picacho, Florence, and Mobile areas in Pinal and Maricopa counties. In light of these circumstances, the Town's conservation strategy would be to mitigate the loss of suitable habitat from development by protecting habitat for the snake outside of the Town. This strategy would result in the acquisition and protection of important suitable habitat that is, where possible, contiguous with other lands receiving protection. The net result over the life of the HCP permit would likely be more suitable habitat receiving regional protection than would occur if the HCP were not implemented. As a result, implementing the HCP will be effective in allowing the shovel-nosed snake to persist or even recover.

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

4.6.1 Population Status and Ecology

Range and Distribution

The total range of lesser long-nosed bats varies somewhat depending on which taxonomic classification is used. *Leptonycteris sanborni* (the former species name for the lesser long-nosed bat) is listed as occupying the lowland deserts of Mexico from Oaxaca and Veracruz through western Mexico to Baja California, and northward to south-central and southeast Arizona and southwest New Mexico. *L. curasoae* is listed as occupying essentially the same range but extending southeasterly through Guatemala to El Salvador.

In Arizona, the lesser long-nosed bat is found from the Picacho Mountains to the Agua Dulce Mountains in the southwest and the Galiuro and Chiricahua mountains in the southeast (Figure 4.6-1). There are also two late-summer records of immature individuals from the Phoenix area and one from the Pinaleno Mountains.

Population Status and Threats

Range-wide Population Status and Threats

The lesser long-nosed bat is currently federally listed as endangered. Populations are believed to have declined significantly, and federal listing was based on the reduction of the number of maternity colonies and declines in the size of remaining maternity colonies in Arizona and Sonora as a result of exclusion and disturbance. Additionally, lesser long-nosed bats are thought to be negatively affected by reductions in the availability of native agaves over large areas of northern Mexico from harvesting for local manufacture of mescal and tequila. Heavy browsing on newly emergent flower stalks of agaves by both cattle and deer also has been suggested as possibly decreasing foraging opportunities and thus contributing to declines in these bats. Although believed to have declined, recent surveys have indicated that population sizes are much larger than those reported in the 1980's (Hinman and Snow 2003).

Arizona Population Status and Threats

Arizona is at the extreme northern edge of the lesser long-nosed bat's distribution. It is a state endangered species. Loss of agaves by grazing, agricultural harvest, and development has reduced foraging habitat for lesser long-nosed bats in Arizona and elsewhere in its range. Loss and disturbance of roosts sites also pose a significant threat to lesser long-nosed bats and can occur through:

- Recreational caving and mine exploration,
- Closure of abandoned mines for hazard abatement,
- Renewed mining,
- Vandalism, and
- Exclusion of bats from roosting areas.

Efforts are underway in some locations to protect known and potential roosts. At three large maternity colonies occur in Arizona, measures have been implemented protect the roosts.

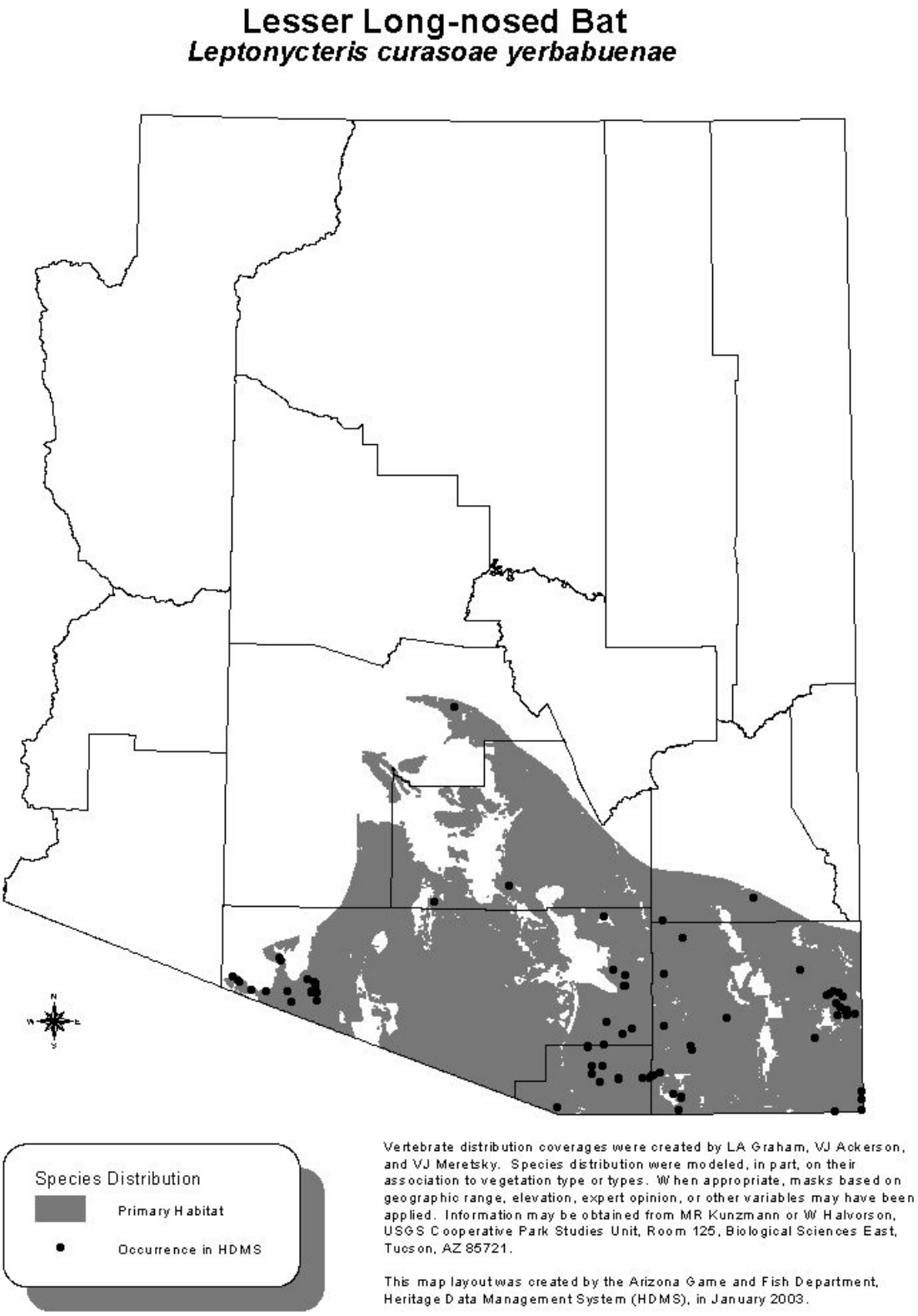

FIGURE 4.6-1
Habitat range and occurrence of the lesser long-nosed bat in Arizona. Points represent all occurrences of 1 or more individuals, including netting records.

Several caves and mine adits in southeastern Arizona have been gated with interpretive signs placed nearby in an effort to protect the suitability of these sites for roosting. Colossal Cave at the base of the Rincon Mountains is developed for tourism but recently steps have been taken to restore parts of the cave in an effort to attract lesser long-nosed bats to use it as a maternity roost as they did until the 1960s.

Life History

Lesser long-nosed bats are migratory since they do not hibernate and cannot withstand prolonged exposure to cold temperatures. In September and October, they migrate to Mexico, where they breed and spend the winter. Females return to Arizona pregnant as early as the second week in April. In late April through late July, pregnant females congregate at traditional roost sites, give birth and raise their young. Maternity colonies may number in the hundreds or thousands and in a few places in the tens of thousands. Males form separate, smaller colonies. Females give birth to one young each year in May. Young can fly by the end of June. Maternity colonies break up by the end of July at which time females and young move to higher elevation areas (up to about 5,500 feet [1,678 m] where they feed on agave flowers. Neither maximum nor mean lifespan are known; however, one banded individual was at least 4 years old when recaptured.

Habitat Requirements

Habitat associations of the lesser long-nosed bat vary seasonally in Arizona. During April until July, the lesser long-nosed bat is known from semidesert grasslands and Sonoran desert scrub at elevations below 3,500 feet (AGFD 2003). From July to late September/early October, this bat moves up to Madrean evergreen woodland (oak transition regions) at elevations up to 5,500 feet (AGFD 2003). Within these plant communities, lesser long-nosed bats require two critical resources: 1) suitable day roosts and 2) sufficient concentrations of food plants. The distribution of these resources will determine where these bats specifically occur.

In Arizona, lesser long-nosed bats feed on nectar and pollen from flowers of saguaro and organ pipe cactus in early summer and agave later in the summer and early autumn. Its consumption of nectar and pollen produced by paniculate agave flowers is well known. Also important are nectar, pollen, and fruit produced by a variety of columnar cacti. Flowers and fruits of two to three species of columnar cacti (*Pachycereus pringlei, Carnegia gigantean, and Stenocereus thurberi*) provide nearly all of the energy and nutrients obtained by pregnant and lactating females roosting in the Sonoran desert in the spring and early summer (USFWS 1995). They may feed on ripe cactus fruits at the end of the flowering season and also may take a few insects incidentally when feeding on nectar. Lesser long-nosed bats have been reported to visit hummingbird feeders at night in the Huachuca, Chiricahua, and Santa Rita Mountains. During winter in Mexico, primary food plants, as identified by their pollen, appear to be *Ceiba, Bombax*, and *Ipomoea*. Their spring migration from central Mexico northward is thought to follow the sequential blooming of certain flowers from south to north.

Lesser long-nosed bats leave daytime roosts to feed about an hour after sunset. After filling their stomachs, sometimes to the point of appearing pregnant, they go to night roosts, which may be different from day roosts, to rest and groom. As they groom themselves they

remove the pollen sticking to their fur with their claws and then lick it off their claws. This ingested pollen provides proteins and other nutrients not obtainable from nectar.

The lesser long-nosed bat is considered an important pollinator of various agave species, columnar cacti and other Mexican plant species. Pollen collects on their heads and shoulders (sometimes making them look yellow) when they stick their head into a flower to get nectar. As they move from plant to plant, pollen is rubbed off on the pistils at each flower thus pollinating them. It is not yet clear just how important this bat is as a pollinator of saguaro and the agave species with which it is associated in Arizona since some populations of these plants also exist well outside the known range of this bat.

For day roosts, the lesser long-nosed bat uses caves, mine tunnels, and occasionally in old buildings. This bat appears to be the most dependent on the availability of inactive mines of the North American bat species. Most Arizona records are from inactive mines. Proximity to humans does not necessarily pose a threat to this species (USFWS 1995). Characteristics that render potential roost sites "suitable" for lesser long-nosed bats are unclear, but maternity roosts tend to be very warm and poorly ventilated, at least where the young are actually raised. These characteristics could reduce the energetic requirements of adult females while they are raising their young (USFWS 1995).

Like many other bats, individuals of Leptonycteris use night roosts for digesting their meals. Night roosts can be the bats' day roosts or other caves, mines, rock crevices, trees and shrubs, and occasionally abandoned buildings (USFWS 1995). The extent to which night roosts represent essential habitat in this species is currently uncertain.

4.6.2 Existing Conditions

Population in and near the Town

According to HDMS (AGFD, unpublished data accessed 2003), there are no known roost sites within the Town of Marana HCP planning area, and the nearest known roost site is 40 miles distant. Historic records indicate populations previously existed in the Picacho Mountains (last observed in 1998) and the Santa Catalina Mountains (last observed prior to 1986). Within Pima County, the largest known maternity roost in North America is found in an abandoned adit in Copper Mountain, in Organ Pipe Cactus National Monument (Pima County 2000a).

Habitat in and near the Town

Suitable roost sites are not believed to occur in the Town, but Sonoran desertscrub habitat within the Town limits provides potential foraging habitat for lesser long-nosed bats (Pima County 2000b). A habitat model for the lesser long-nosed bat was developed as part of the Sonoran Desert Conservation Plan (RECON 2002). This habitat model consisted of the following four primary variables

- Elevation
- Slope
- Carbonates
- Vegetation.

The habitat potential of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provide no habitat potential and 3 indicating that the category provided high potential habitat. The four variables were combined to provide an overall habitat potential rating. Table 4.6-1 shows the specific categories of the four variables considered to provide habitat for the lesser long-nosed bat and their habitat potential ratings. Using this habitat model, the Town of Marana supports 21,106 acres of high potential habitat for lesser long-nosed bats (Figure 4.6-2). The SDCP does not identify any areas with Marana as being priority conservation areas or areas identified as being of value to the reserve system (Pima County 2000a).

TABLE 4.6-1
Habitat potential ratings for characteristics of the variables used in the lesser long-nosed bat habitat model in the SDCP

Variable/Category	Habitat Potential Rating
ELEVATION	
194 to 400 meters	2
401 to 600 meters	2
601 to 800 meters	2
801 to 1000 meters	2
1001 to 1200 meters	2
1201 to 1400 meters	2
1401 to 1600 meters	2
1601 to 1800 meters	2
1807 to 2000 meters	2
SLOPE	
Moderate	3
Steep	3
Flat within ½ mile of Moderate to Steep Slopes	2
Flat within 2 miles of Moderate to Steep Slopes	1
CARBONATES	
Carbonates	2
Area within 1 mile of carbonates	1
VEGETATION	
Pinyon-Juniper (122.41)	1
Pine (122.82)	1
Encinal (Oak) (123.31)	1
Oak-Pine (123.32)	1

TABLE 4.6-1
Habitat potential ratings for characteristics of the variables used in the lesser long-nosed bat habitat model in the SDCP

Variable/Category	Habitat Potential Rating
Manzanita (133.32)	1
Mixed Evergreen Sclerophyll (133.36)	1
Mixed Grass-Scrub (143.15)	1
Shrub-Scrub Disclimax (143.16)	1
Paloverde-Mixed Cacti (154.12)	2
Urban (999.2)	2

Source: Recon (2002) Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan.

Relation to Species' Range and Ecology

The nearest known maternity colony is approximately 40 miles northwest of Marana (Old Mammon Mine); although historic records indicate that there were maternity colonies within approximately 25 miles (Picacho Peak) and 35 miles (Colossal Cave). Known non-maternity sites are 25 miles northeast of Marana (Santa Catalina Mountains) and 40 miles south of Marana (Cave of Bells) (USFWS 2002b, 2002c, 2000a). The nearest recorded individual was documented in the Santa Catalina Mountains, approximately 20 miles east of the Town's northeastern boundary. All of the known roost sites in Pima County are protected by land management agencies and large areas of potential forage habitat can be found with the various National Parks, Monuments, and Wildlife Refuges (Pima County 2000a)

There is little potential for colonies to occur in Marana. The Tortolita Mountains, which extend into the northeastern portion of Marana, have no history of significant mining activity and there are no known mine tunnels which could be used as maternity roosts by the bats. The very northern end of Tucson Mountains extends into southwestern Marana, but this area also has no history of mining activity and no documented bat records.

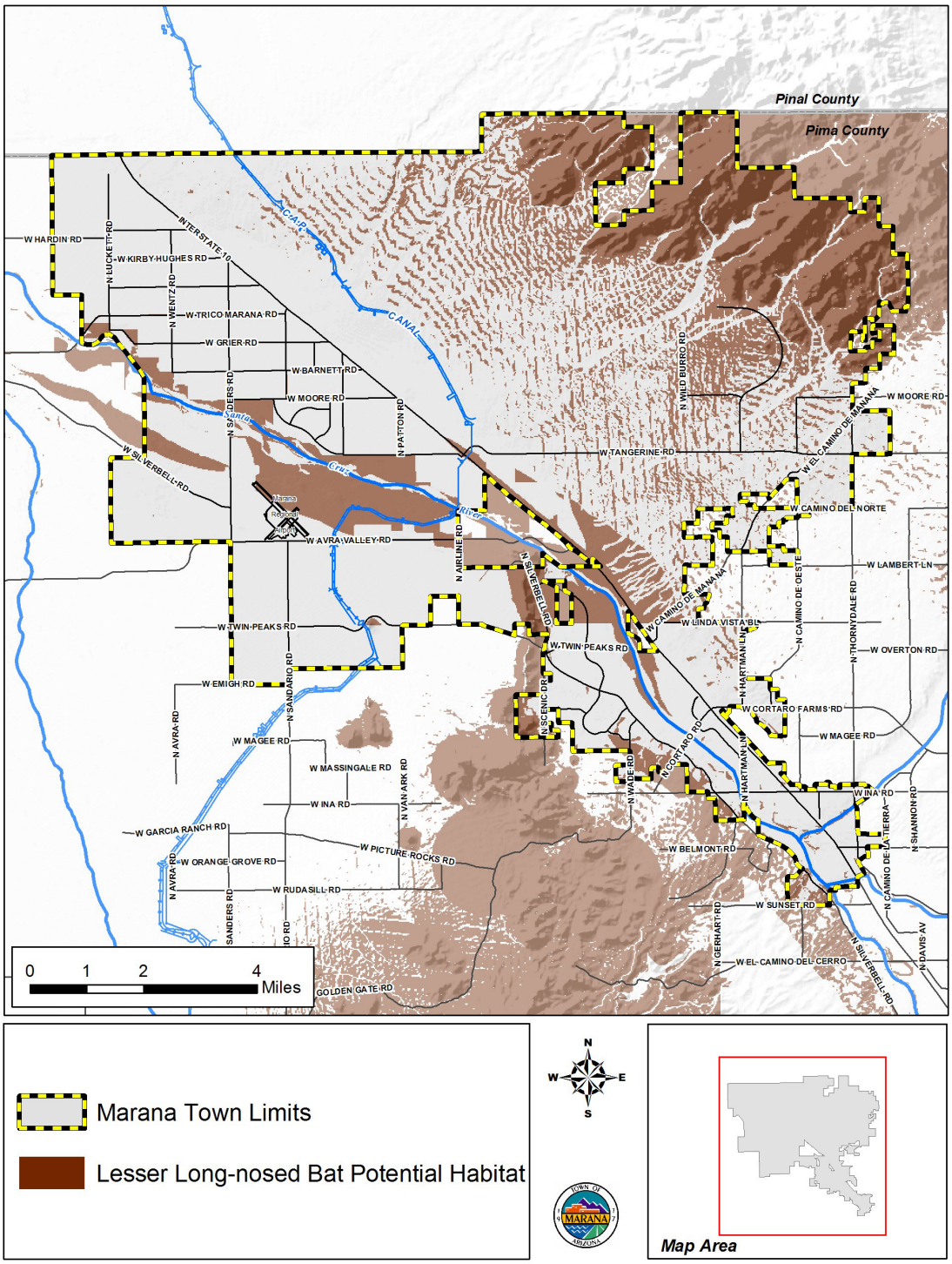

FIGURE 4.6-2
Lesser long-nosed bat existing potential habitat

Bats have been recorded flying as far as 40 miles (one way) from roost sites to forage sites. Based on this information, portions of Marana could, potentially, provide foraging habitat for lesser long-nosed bats. The extent of use of the Marana area by foraging bats has not been determined but given the distance of habitat in the Town from the nearest known roosts (25 to 40 miles), the level of use is likely low.

Local and regional movements of lesser long-nosed bats are largely unknown. However, given Marana's location and that the Town appears to support suitable foraging habitat for the bats, Marana could serve as a corridor for movement between roosts in the Slate Mountains and Santa Rita Mountains, as well as for seasonal migrations.

4.6.3 Potential Impacts of Town's Proposed Activities

Direct Effects

Lesser long-nosed bats roost in caves and mines. No known roost sites occur in the Town and no suitable roost sites are expected to occur in areas of projected urban development. Therefore, take of bats from disturbance or destruction of roosts during construction activities is not anticipated. Noise and other construction-related disturbance could cause individual bats to move to other foraging areas, potentially increasing energetic demands and increasing the vulnerability of bats. However, since bats forage at dusk or night when construction activities typically are not being conducted there is little potential for disturbance. Further, no lesser long-nosed bats have been documented within Marana and given the distance of the HCP area from known roosts, the number potentially affected is probably low.

Indirect Effects

Lesser long-nosed bats can be adversely affected through indirect mechanisms facilitated or caused by urban development. Specifically, lesser long-nosed bats are vulnerable to disturbance at roost sites. Because the Town does not support suitable roost sites for lesser long-nosed bats, these potential effects are not anticipated.

Changes in Habitat

Based on the Town of Marana's General Plan, 12,672 acres of high potential habitat for lesser long-nosed bats would be developed. Of this acreage, 3,154 acres would be in areas planned for high and moderate intensity development, 9,451 acres would be in low intensity areas, and 67 acres would be roads. Suitable foraging habitat could remain in portions of the areas proposed for low intensity development. Under this proposed development, 8,832 acres of high potential habitat for lesser long-nosed bats would remain in the Town. It is important to recognize that not all of the potential habitat identified in the Town provides suitable habitat for lesser long-nosed bats or is used by bats. The habitat model identifies general vegetation and physical conditions that could support suitable conditions for lesser long-nosed bats but does not distinguish small scale conditions that determine where bats occur (i.e. potential day roost sites, presence of saguaros or other columnar cacti).

The loss in potential foraging habitat for lesser long-nosed bats in the Town habitat loss has the potential to result in take as a result of reduced foraging opportunities. Because the nearest known roosts are 25 miles or more from the Town, the extent of use of habitats in

the Town for foraging by lesser long-nosed bats is probably very low. As a result, a reduction in the amount the potential foraging habitat in the Town is not likely to substantially reduce foraging opportunities for this species. This conclusion is consistent with the USFWS's determinations that several development project in Marana were "not likely to adversely affect" lesser long-nosed bats (USFWS 2000a, 2000b, 2002a, 2002b).

Population Effects

Urban development in the Town could reduce the potential foraging habitat associated with five present or historic roosting locations (Picacho Mountains, Slate Mountains/Old Mammon Mine, Santa Catalina Mountains, Cave of Bells, and Santa Rita Mountains). For at least two of these sites, however, Marana is on the extreme end of potential foraging range (approximately 40 miles).

The level of use of habitats in Marana by foraging and migratory bats is unclear and the potential for population effects will depend on whether roosting sites or foraging habitat represents the more limiting factor for the bats. For most of the known roost sites (both current and historic), foraging habitat closer than that in Marana exists. However, if foraging habitat outside of Marana is reduced, then foraging habitat within Marana could become more important and reductions in this habitat from urban development could contribute to reductions in bat populations that roost elsewhere.

The SDCP habitat model predicts that Pima County supports nearly 2 million acres of potential habitat. Of this total, urban development in Marana would impact 12,672 acres of potential foraging habitat for lesser long-nosed bats (less than 1%). Considering the low level of use of habitat in the Town by lesser long-nosed bats and the amount of habitat available outside of the Town, the loss of potential foraging habitat in the Town is not likely to impact the overall population size and distribution of lesser long-nosed bats.

4.6.4 Biological Goals and Objectives

As described above, lesser long-nosed bats are not expected to roost in the Town but may forage in the Town from roosts outside the Town or during their seasonal migrations. To the extent that lesser long-nosed bats use habitats in the Town, the Town's biological goal is to

- Contribute to maintaining regional populations of lesser long-nosed bats.

The Town's specific objective is to

- Provide foraging opportunities for lesser long-nosed bats during their summer residency period and migration.

4.6.5 Conservation Measures

The conservation objective for lesser long-nosed bats consists of ensuring that foraging opportunities will remain in the Town. Lesser long-nosed bats forage on nectar from saguaro and columnar cacti which occur in the Town principally in the Tortolito fan in the northwestern portion of the Town. This area is also the focus of the cactus ferruginous pygmy owl conversation strategy. The two cactus ferruginous pygmy-owl conservation strategies include retention of habitat for pygmy-owls and would result in retaining habitat for the lesser long-nosed bat as well. The burrowing owl conservation strategy also would

encompass habitat for lesser long-nosed bats. These two strategies would ensure that foraging opportunities for lesser long-nosed bats are maintained in the Town and no additional conservation measures are necessary to achieve the conservation goals and objectives for this species. The following summarizes the components of the two pygmy owl conservation strategies and the burrowing owls conservation strategy that will benefit lesser long-nosed bats. The complete text of these measures is provided in the *Section 4.2 Cactus Ferruginous Pygmy-owl* and *Section 4.3 Burrowing Owl*.

Cactus Ferruginous Pygmy-Owl Conservation Strategy

Strategy A – Section 7-based Approach

- The Town will, through ordinance or some other appropriate and legally binding mechanism:
  - Limit surface disturbance to 30 to 60 percent in the area north of Cortaro Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of the eastern Town boundary
  - Minimize disturbance to protected desert vegetation
  - Minimize use of non-native or invasive plant species as landscaping (Pygmy-owl Measure - A1).
- The Town will establish three pygmy-owl conservation zones in the Town with development restrictions as follows
  - Zone 1: Surface disturbance will be limited to 20 to 30 percent maximum disturbance[1].
  - Zone 2: Surface disturbance will be limited to 40 percent maximum disturbance[1].
  - Zone 3: Corridors will be preserved by establishing a 300-foot buffer along washes with a 100-year discharge greater than 500 cfs (Pygmy-owl Measure - A2).

Strategy B – Augmentation Approach

- The Town will acquire State Trust Lands in the Tortolita fan to set aside as a permanent preserve with 16,200 acres of habitat for the cactus ferruginous pygmy-owl. This area is in addition to an existing 2,400-acre preserve currently leased by the Town and which will be purchased and managed for conservation purposes. The preserve will roughly consist of all State Trust Land beginning 3,600 feet north of Tangerine Road, and from the CAP canal east to the Town boundary (Pygmy-owl Measure - B1).
- The Town will, by ordinance or some other appropriate and legally binding mechanism:
  - Limit surface disturbance to 30 to 60 percent in the north of Magee Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of a line corresponding to the Shannon Road alignment

[1] Under certain specified conditions surface disturbance can be greater than 30% in Zone 1 and greater than 40% in Zone 2. See Pygmy Owl Measure A2 in Section 4.2 Cactus Ferruginous Pygmy-Owl for the full text of the measure.

- Disturbance to protected desert vegetation will be minimized
- Use of non-native or invasive plant species as landscaping will be minimized (Pygmy-owl Measure - B3).

- The Town will preserve corridors between the preserve and habitat to the south of the preserve. These corridors will, at a minimum, consist of five 300-meter (984-foot) wide corridors centered on the five largest washes crossing Tangerine Road (Pygmy-owl Measure – B4).
- The Town will preserve dispersal corridors across Interstate-10 by requiring establishment of 300-foot buffer along washes with a 100-year discharge greater than 500 cfs (Pygmy-owl Measure – B5).

Burrowing Owl Conservation Strategy

- The Town will prohibit, to the extent possible, development within the floodway of the Santa Cruz River. The Town will discourage those activities within the floodplain which are allowable under current zoning or permitting processes and which, if prohibited, could constitute a taking of property (Burrowing Owl Measure – 1).

4.6.6 Monitoring and Adaptive Management

Since the conservation objectives for lesser long-nosed bats would be achieved with implementation of the cactus ferruginous pygmy-owl and burrowing owl conservation strategies, compliance monitoring for lesser long-nosed bats is encompassed by the compliance monitoring for the pygmy-owl.

Effectiveness monitoring addresses whether the conservation measures are achieving the biological goals and objectives. For lesser long-nosed bats, effectiveness monitoring and adaptive management is not necessary or useful in this HCP. The biological goal for lesser long-nosed bats is to contribute to maintaining regional populations with the specific objective of maintaining foraging opportunities. The pygmy-owl and burrowing owl conservation strategies will result in the retention of a large amount of potential foraging habitat for lesser long-nosed bats. Thus, the objective of providing foraging opportunities will be met. Whether and to what degree long-nosed bats use foraging habitat in the Town depends on many factors including how far roosts are from the Town and the availability and quality of foraging habitat outside of the Town. These factors are outside of the Town's control. As a result, it would not be possible to determine if a lack of use of habitats in the Town by long-nosed bats was because of habitat conditions in the Town or conditions outside of the Town. Further, beyond preserving suitable foraging habitat as under the HCP, it is unlikely that the Town could implement any other actions to provide foraging opportunities for the bats.

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

No roost sites for lesser long-nosed bats are known or expected to occur in the Town. Thus, potential effects to lesser long-nosed bats from urban development consist of effects from changes in the availability of foraging habitat. Proposed future development in the Town could impact 12,672 acres of potential foraging habitat for lesser long-nosed bats. Although the Town does contain suitable foraging habitat for the lesser long-nosed bat, because

known roost sites are a considerable distance from the Town (greater than 25 miles), the level of use of foraging habitat in the Town by lesser long-nosed bats is probably limited. The Town's conservation approach to lesser long-nosed bats is to retain potential foraging habitat for the lesser long-nosed bats. With implementation of the cactus ferruginous pygmy-owl conservation strategy, foraging habitat for lesser long-nosed bats would be conserved. The amount of habitat and to some extent its configuration would depend on which pygmy-owl conservation strategy. Thus, effects of implementing each of the two pygmy owl conservation strategies in combination with burrowing owl conservation strategy are described individually.

Cactus Ferruginous Pygmy Owl Conservation Strategy A – Section 7-based Approach

The primary measures in Strategy A for pygmy owls that would benefit lesser long-nosed bats are Pygmy-Owl Measure – A1 and Pygmy-Owl Measure – A2. Under Measure A1, the Town would enact an ordinance which would limit surface disturbance to 30 to 60 percent and minimize disturbance to protected desert vegetation. Measure - A2 would further restrict surface disturbance in a portion of the area covered by the ordinance. About 7,630 acres of foraging habitat for lesser long-nosed bats occurs in Zone 1 of Measure – A2 in which surface disturbance would be limited to 20 to 30 percent (Figure 4.6-3). Zone 2 of Measure – A2 would encompass 7,389 acres of potential lesser long-nosed bat habitat and surface disturbance could be 30 to 60 percent as under Measure A2 (Figure 4.6-3).

Assuming a worst case scenario of 30 percent disturbance in Zone 1 and 60 percent disturbance in Zone 2, 8,519 acres of potential foraging habitat for lesser long-nosed based would be retained under this strategy. In addition to the habitat retained because of restrictions on surface disturbance, the Town would require establishment of buffers at 300 feet wide along washes with a 100-year discharge greater than 500 cfs in Zone 3 identified under Measure - A2. About 49 acres of potential foraging habitat would remain in Zone 3.

Under the Burrowing Owl Conservation Strategy, the Town would prohibit development in the Santa Cruz River floodplain (Burrowing Owl – 1). By prohibiting development in the floodplain, the Town can encourage the long term availability of foraging opportunities along the river to the extent of its authority. Burrowing Owl Measure – 1 would encompass 1,684 acres of foraging habitat for lesser long-nosed bats. Through implementation of the burrowing owl and pygmy owl conservation strategies (Strategy A) 10,498 acres of potential foraging habitat for lesser long-nosed bats would be retained in the Town. This acreage represents about 50 percent of the total amount of foraging habitat currently supported in the Town. To the extent that lesser long-nosed bats currently forage in the Town, implementation of the HCP would preserve foraging opportunities over the long-term.

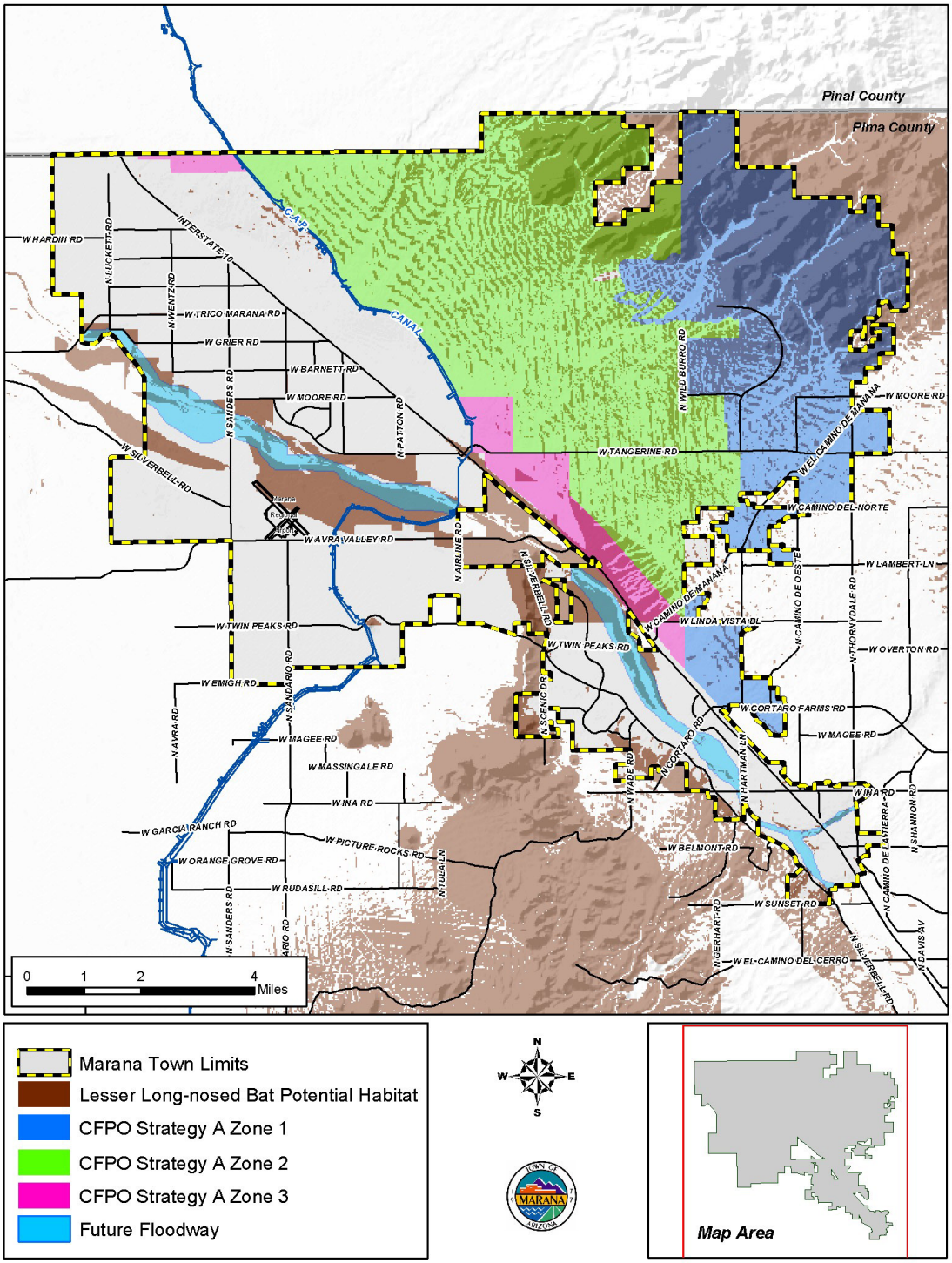

FIGURE 4.6-3
Existing potential habitat for lesser long-nosed bat and proposed zones under CFPO Strategy A.

Cactus Ferruginous Pygmy Owl Conservation Strategy B – Augmentation Approach

Four of the five measures in Conservation Strategy B for pygmy-owls would benefit lesser long-nosed bats through protection of native desert habitat. Under Pygmy Owl Measure - B1, the Town would acquire 18,600 acres of State Trust Lands in the Tortolita fan. About 8,446 acres of habitat for the lesser long-nosed bat is encompassed by the area that would be preserved. The burrowing owl conservation strategy would result in the retention of an additional 1,684 acres of foraging habitat in the Santa Cruz River floodway (Burrowing Owl – 1). These two measures would result in the preservation of 10,130 acres of potential foraging habitat the lesser long-nosed bats (Figure 4.6-4).

In addition to incorporating 10,130 acres (about 48%) of the existing habitat for lesser long-nosed bats in a preserve, potential foraging opportunities would be retained in many areas outside of the designated preserve. Under Pygmy Owl Measure B-3, the Town would implement an ordinance under which surface disturbance would be limited to 60 percent. Undisturbed areas would be retained in native desert vegetation, thus providing potential foraging opportunities for lesser long-nosed bats. Foraging habitat also would be retained in habitat corridors to be established along the five largest washes crossing Tangerine Road (Pygmy-owl Measure B-4). In total about 14,500 acres of habitat for lesser long-nosed bats would remain in the Town. This acreage constitutes nearly 70 percent of the habitat currently occurring in the Town.

With implementation of Cactus Ferruginous Pygmy-owl Conservation Strategy B, about one-half of the potential foraging habitat for lesser long-nosed bats would be undisturbed and protected in habitat preserves. Additional foraging opportunities would be available in open space areas required to be retained in association with developments. To the extent that lesser long-nosed bats currently forage in the Town, implementation of the HCP would preserve foraging opportunities over the long-term.

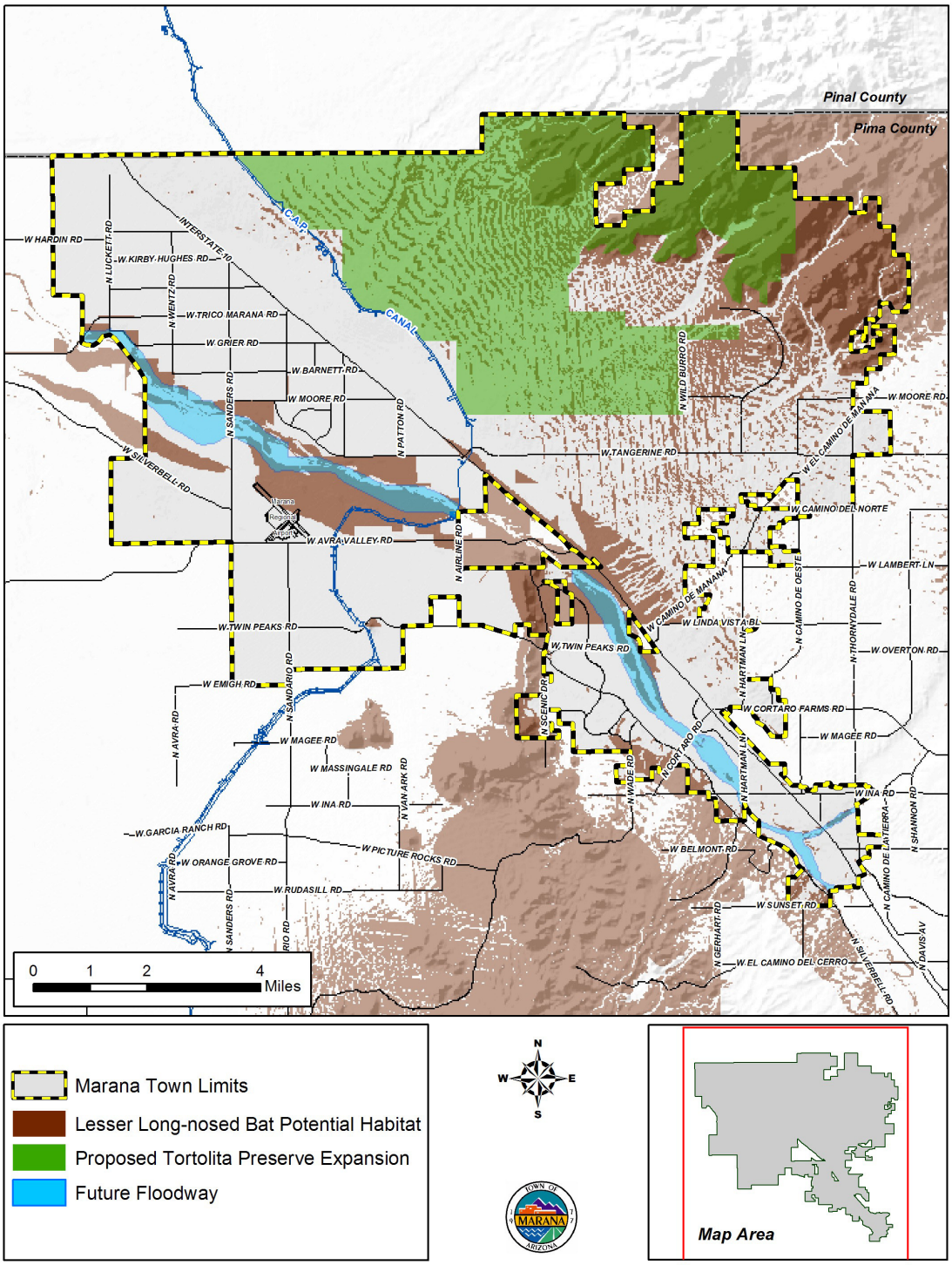

FIGURE 4.6-4
Existing potential habitat for lesser long-nosed bat and proposed Tortolita Preserve Expansion under CFPO Strategy B.

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

4.7.1 Population Status and Ecology

Range and Distribution

The pale Townsend's big-eared bat ranges throughout western North America from southern British Colombia south through the Pacific Northwest and southern California on the west and the Black Hills of South Dakota and West Texas on the east through the Mexican uplands to the Isthmus of Tehuantepec in southern Mexico. It is not known from the Baja California peninsula. Isolated occurrences in the southern Great Plains, Ozark Mountains and Appalachian Mountains are considered to be relict populations.

The species is widespread throughout Arizona, although not considered common anywhere, and is least common in northeastern grasslands and southwestern desert areas. It has been found from 550 to 7,520 ft (168 – 2,294 m) in elevation. Most records, however, come from above 3,000 ft (915 m) (Hinman and Snow 2003). In Arizona, pale Townsend's big-eared bats have been reported in Cochise, Coconino, Gila, Graham, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, and Yuma counties (AGFD, unpublished records accessed 2003; Figure 4.7-1).

Population Status and Threats

Range-wide Population Status and Threats

The overall population status and trend of pale Townsend's big eared bat is uncertain but the species is believed to have declined in parts of its range. A survey by Pierson and Rainey (1994) suggested that substantial population declines in pale Townsend's big-eared bats have occurred in California over the last 40 to 60 years. Evidence for substantial declines consists of a

- 52 percent loss in the number of maternity colonies,
- 44 percent decline in the number of roosts,
- 55 percent decline in the number of animals, and
- 32 percent decrease in the average size of remaining colonies in California.

The lower Colorado desert along the Colorado River, an area that experiences heavy recreational use, is one of three areas in California in which marked declines in the numbers of pale Townsend's big-eared bat colonies have taken place.

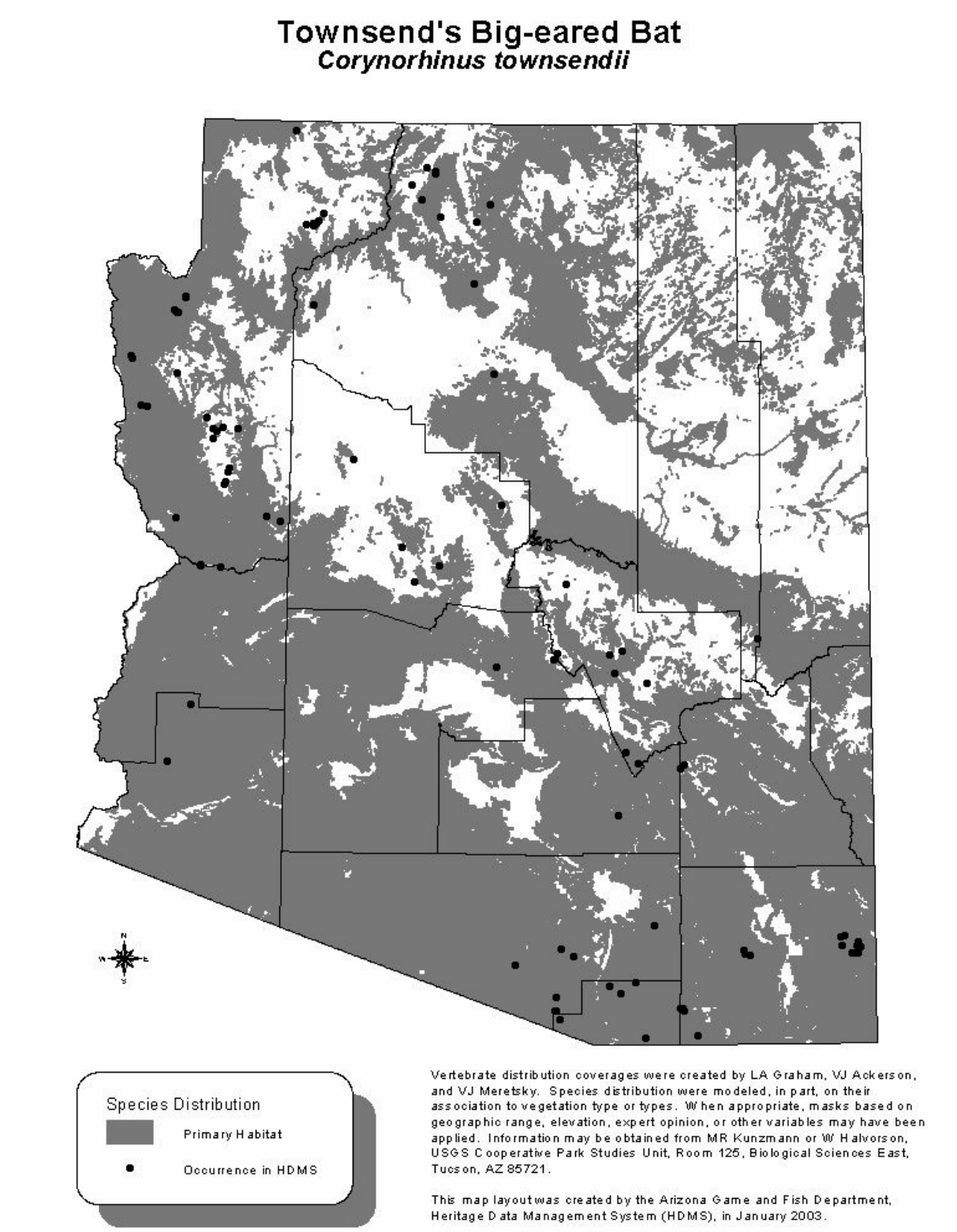

FIGURE 4.7-1:
Habitat range and occurrence of Townsend's big-eared bat in Arizona. Points represent maternity colonies, roosts of 5 or more individuals, sites where 5 or more males have been netted, and sites where pregnant or lactating females have been netted.

The pale Townsend's big-eared bat is threatened by

- human disturbance at major maternity roosts
- renewed mining
- closure and sealing of abandoned mines naturally or for hazard abatement
- vandalism at maternity and hibernation sites
- loss of foraging habitat, and possibly
- exposure to pesticides (AGFD 2003).

Pale western big-eared bats are extremely sensitive to human disturbance, and simple entry into a maternity roost can result in the abandonment of the site (Pierson et al. 1991). This bat feeds heavily on noctid moths, which require wetland habitats such that declines in wetland habitats also could contribute to bat population declines.

Arizona Population Status and Threats

Population trends for Townsend's big-eared bats in Arizona are unclear, but losses of and reductions in bat numbers at maternity colonies have been reported (Hinman and Snow 2003). In Arizona, five to seven maternity colonies have been found with numbers of 100 to several hundred bats. The largest colony disappeared in the 1970s shortly after the roost site was gated to protect archeological and paleontological remains. After the gate was modified in the mid-1980s, several bat species (but not *C. townsendii*) were observed flying inside the site. Current bat use of these sites is not known (AGFD 2003).

Life History

Pale Townsend's big-eared bats are active in summer but hibernate in winter. They mate in autumn and winter and sperm is stored in the female's reproductive tract until spring. Fertilization occurs at the time of ovulation. Males produce few sperm in their first autumn and are considered to be largely sterile and probably nonbreeding. In contrast, females breed in their first autumn and bear young the following summer. Gestation varies from 56 to 100 days after fertilization depending on climatic conditions and the resultant metabolic rates of the females (i.e. development slows when females go into daily torpor).

In summer, males and females congregate in same sex groups. Females form maternity colonies of 12 to about 200. In Arizona, females are pregnant in April and maternity colonies have been reported in late April. Indirect evidence (near term embryos and presence of newborns) indicates the single young are born in June in Arizona. Dates of birth vary considerably throughout their range being reported from late April to mid July. In Arizona most young are flying by the end of July and nursery colonies begin to disperse during August. Band recoveries in California suggest a maximum longevity of at least 16 years.

Habitat Requirements

In Arizona, summer day roosts use caves and mines in areas of desertscrub; oak woodlands; and oak/pine, pinyon/juniper, and coniferous forests. Pale Townsend's big-eared bats prefer to hang from open ceilings at roost sites and do not use cracks or crevices. At maternity roosts, these bats apparently prefer the dim light near the edge of the lighted zone. In Arizona, emergence times and especially return times and patterns probably vary, as they do elsewhere depending on insect activity and development stage of young. Night roosts are often in abandoned buildings.

In winter, big-eared bats hibernate in cold caves, lava tubes and mines. In Arizona, hibernation sites are mostly in upland and mountainous areas from the vicinity of the Grand Canyon to the southeastern part of the state. Winter roosts generally contain fewer individuals (usually singles or small groups, and in Arizona, occasionally as many as 50) than summer roosts. For hibernation they prefer roost sites where the temperature is 12° C (54° F) or less. Such sites may be near entrances or in well-ventilated areas of the roost. The bats may arouse and move to other spots in the roost during the winter so as to be in areas of stable cold temperatures (Hinman and Snow 2003).

Foraging occurs over desert scrub, riparian habitats, wetlands or open water, typically within 15 miles of the roost sites. Small moths, 3 to 10 mm (average of about 6 mm), are the primary food of these bats. Neuropterans, coleopterans, dipterans and hymenopterans are also sometimes taken. They are reported to take prey from leaves and while in flight along forested edges. Following a late night peak of activity they usually go to a night roost. They may forage again in the early morning since they are reported not to return to their daytime roosts until shortly before sunrise (Hinman and Snow 2003).

4.7.2 Existing Conditions

Population in and near the Town

According to HDMS (AGFD, unpublished data accessed 2003), there are no known roost sites within the Town of Marana HCP area. In Pima County, this species is known to use Colossal Cave Mountain Park, Tucson Mountain Park, Organ Pipe Cactus National Monument, and Saguaro National Park (Pima County 2000a).

Habitat in and near the Town

A habitat model for the pale Townsend's big-eared bat was developed as part of the Sonoran Desert Conservation Plan (RECON 2002). This habitat model consisted of the following eight primary variables:

- Elevation
- Slope
- Aspect
- Carbonates
- Perennial Streams
- Intermittent Streams
- Springs
- Vegetation.

The habitat potential of the categories of each variable were ranked as 0, 1, 2, and 3, with 0 indicating that the category provided no habitat and 3 indicating that the category provided high potential habitat. The eight variables were combined to provide an overall habitat potential. Table 4.7-1 shows the specific categories of the eight variables considered to provide habitat for the pale Townsend's big-eared bat and their habitat potential ratings. Using this habitat model, the Town of Marana supports about 11,254 acres of high potential habitat for pale Townsend's big-eared bat. This potential habitat predominantly occurs in the northeastern portion of the Town although a small amount occurs on the south side of the Santa Cruz River (Figure 4.7-2).

TABLE 4.7-1
Habitat potential ratings for characteristics of the variables used in the pale Townsend's big-eared bat habitat model in the SDCP

Variable/Category	Habitat Potential Rating
ELEVATION	
194 to 400 meters	1
401 to 600 meters	1
601 to 800 meters	1
801 to 1000 meters	1
1001 to 1200 meters	2
1201 to 1400 meters	2
1401 to 1600 meters	2
1601 to 1800 meters	2
1807 to 2000 meters	2
2001 to 2200 meters	2
2201 to 2400 meters	2
2401 to 2600 meters	2
2601 to 2800 meters	2
SLOPE	
Moderate	3
Steep	3
Flat within ½ mile of Moderate to Steep Slopes	2
Flat within 2 miles of Moderate to Steep Slopes	1
ASPECT	
South (157.5-202.5)	1
Southwest (202.5-247.5)	2
West (247.5-292.5)	2
Northwest (292.5-337.5)	1
CARBONATES	
Carbonates	2
Area within 1 mile of carbonates	1
HYDROLOGY	
Intermittent Stream	1

TABLE 4.7-1
Habitat potential ratings for characteristics of the variables used in the pale Townsend's big-eared bat habitat model in the SDCP

Variable/Category	Habitat Potential Rating
Perennial Stream	1
Spring	1
VEGETATION	
Pinyon-Juniper (122.41)	2
Douglas-Fir-Mixed Conifer (122.61)	2
Pine (122.82)	2
Encinal (Oak) (123.31)	2
Oak-Pine (123.32)	2
Mesquite (124.71)	1
Manzanita (133.32)	1
Mixed Evergreen Sclerophyll (133.36)	1
Sacaton-Scrub (143.14)	1
Mixed Grass-Scrub (143.15)	1
Shrub-Scrub Disclimax (143.16)	1
Creosotebush-Tarbush (153.21)	1
Mixed Scrub (153.26)	1
Creosote-Bursage (154.11)	2
Paloverde-Mixed Cacti (154.12)	2
Agriculture (999.1)	1
Urban (999.2)	1

Source: Recon (2002) Priority Vulnerable Species Analysis and Review of Species Proposed for Coverage by the Multiple Species Conservation Plan.

Relation to Species' Range and Ecology

The level of use and potential importance of habitats in the Town of Marana for pale Townsend's big-eared bat is uncertain. No roost sites are known to occur in the Town and are not likely to occur as there are no known mines in the portions of the Tortolita and Tucson Mountains in the Town. Several roosts are known outside of the Town. Potentially bats from these roosts could forage in portions of the Town. However, these roosts are farther than 15 miles from the Town, suggesting little potential use by bats from these roosts.

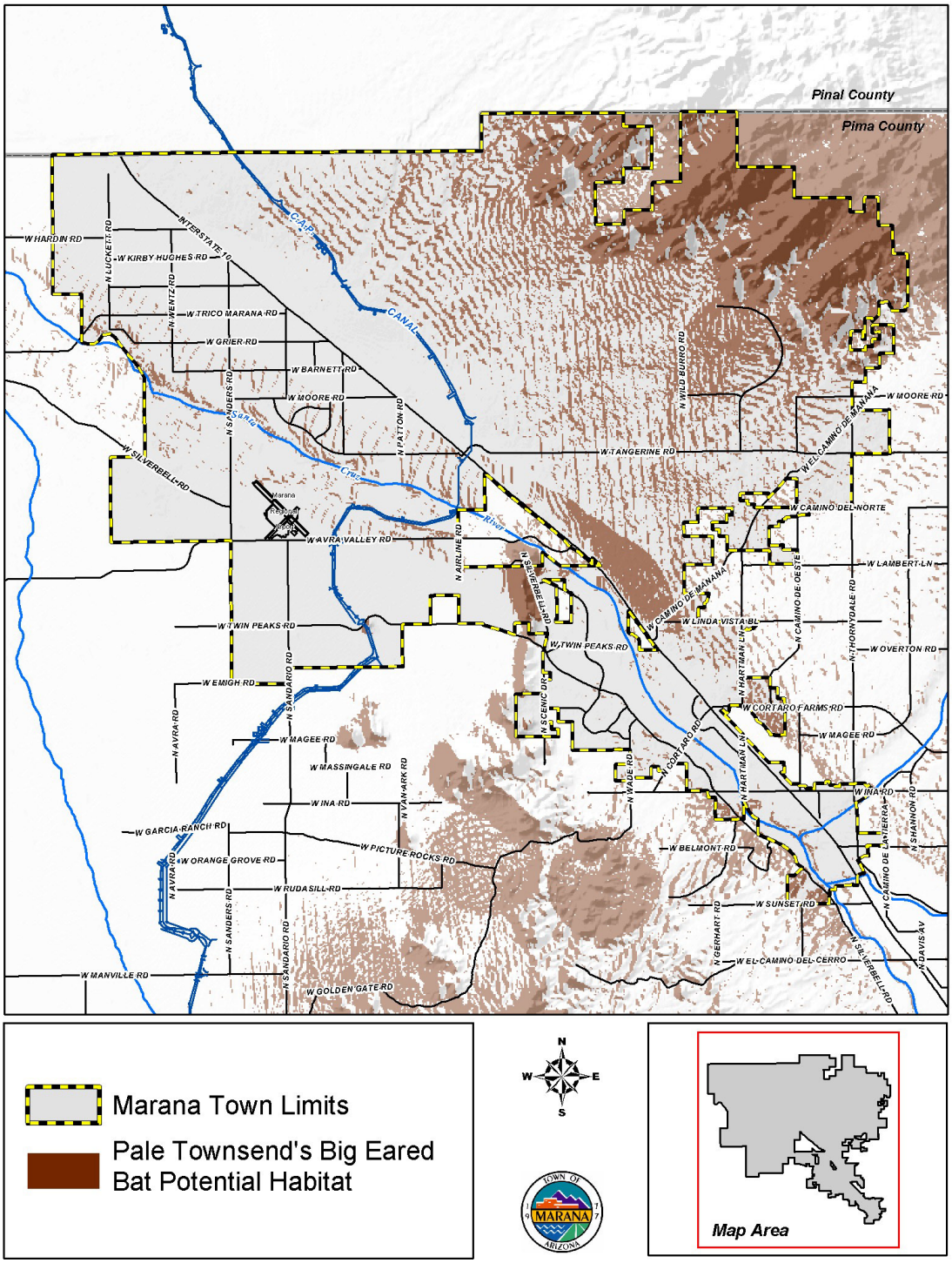

FIGURE 4.7-2
Pale Townsend's big-eared bat existing potential habitat

4.7.3 Potential Impacts of Town's Proposed Activities

Direct Effects

Big-eared bats require caves or mines as hibernacula and maternity roosts. No known roost sites occur in the Town and no suitable roost sites are expected to occur in areas of projected urban development. Therefore, take of bats from disturbance or destruction of roosts during construction activities is not anticipated. Noise and other construction-related disturbance could cause individual bats to move to other foraging areas, potentially increasing energetic demands and increasing the vulnerability of bats. However, since these bats forage at night or dawn when construction activities typically are not being conducted there is little potential for these types of effects. Further, pale Townsend's big eared bats have not been documented within Marana and given the distance of the HCP area from known roosts, the HCP area is probably not heavily used by this species.

Indirect Effects

Indirect effects from urban development include the potential for disturbance and vandalism at roost sites as a result of increased human activity associated with urban development. Because the Town does not appear to support suitable roost sites for pale Townsend's big-eared bats, these potential effects are not anticipated.

Changes in Habitat

Potential effects to big-eared bats from the proposed covered activities primarily relate to changes in foraging opportunities. Urban development could impact 7,294 acres of high potential foraging habitat for this species. Of this total, 6,027 acres would be affected by low intensity development and some foraging opportunities may remain in these areas. The remaining 1,267 acres of high potential habitat would be affected by high intensity development or road improvements. This habitat loss has the potential to result in take of big-eared bat through reduced foraging opportunities if big-eared bats forage in the Town. Because the nearest known roosts are farther than 15 miles from the Town, the extent of use of habitats in the Town for foraging by big-eared bats is probably low. As a result, a reduction in the amount the potential foraging habitat in the Town is not likely to substantially reduce foraging opportunities for this species.

Population Effects

Pale Townsend's big-eared bats are not likely to be affected by urban development and associated infrastructure projects in the Town. Available information suggests a low level of use of habitats in the Town because known roost sites occur well outside of the Town. The SDCP habitat model predicts that Pima County supports about 1.3 million acres of high potential habitat. Of this total, urban development in Marana would impact 11,483 acres (less than 1%) of high potential habitat. Given the believed low level of use of foraging habitat in the Town and the abundance of potential habitat elsewhere in Pima County, the reductions in potential foraging habitat for pale Townsend's big-eared bat would not be expected to affect to this species' population.

4.7.4 Biological Goals and Objectives

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

- Contribute to maintaining regional populations of pale Townsend's big-eared bats.

The Town's specific objective is to

- Provide foraging opportunities for pale Townsend's big-eared bats.

4.7.5 Conservation Measures

The conservation objective for Townsend's big-eared bats consists of ensuring that foraging opportunities remain in the Town. Pale Townsend's big-eared bats forage in a diversity of habitats, but with a preference for wetland and riparian areas. Foraging habitat for Townsend's big-eared bats will be retained in the Town through implementation of the cactus ferruginous pygmy owl conservation strategy and the burrowing owl conservation strategy. With these two strategies, no additional conservation measures are necessary to achieve the conservation goals and objectives for Townsend's big-eared bats. The following summarizes the components of the two alternative pygmy owl conservation strategies and the burrowing owls conservation strategy that will benefit pale Townsend's big-eared bats. The complete text of these measures is provided in the *Section 4.2 Cactus Ferruginous Pygmy-owl* and *Section 4.3 Burrowing Owl.*

Cactus Ferruginous Pygmy-Owl Conservation Strategy

Strategy A – Section 7-based Approach

- The Town will through ordinance or some other appropriate and legally-binding mechanism:
  - Limit surface disturbance to 30 to 60 percent in the area north of Cortaro Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of the eastern Town boundary
  - Minimize disturbance to protected desert vegetation
  - Minimize use of non-native or invasive plant species as landscaping (Pygmy-owl Measure - A1).
- The Town will establish three pygmy-owl conservation zones in the Town with development restrictions as follows
  - Zone 1: Surface disturbance will be limited to 20 to 30 percent maximum disturbance[1].
  - Zone 2: Surface disturbance will be limited to 40 percent maximum disturbance[1].

[1] Under certain specified conditions surface disturbance can be greater than 30% in Zone 1 and greater than 40% in Zone 2. See Pygmy Owl Measure - A2 in Section 4.2 Cactus Ferruginous Pygmy-Owl for the full text of the measure.

- Zone 3: Corridors will be preserved by establishing a 300-foot buffer along washes with a 100-year discharge greater than 500 cfs (Pygmy-owl Measure - A2).

Strategy B – Augmentation Approach

- The Town will acquire State Trust Lands in the Tortolita fan to set aside as a permanent preserve with 16,200 acres of habitat for the cactus ferruginous pygmy-owl. This area is in addition to an existing 2,400-acre preserve currently leased by the Town and which will be purchased and managed for conservation purposes. The preserve will roughly consist of all State Trust Land beginning 3,600 feet north of Tangerine Road, and from the CAP canal east to the Town boundary (Pygmy-owl Measure - B1).
- The Town will through ordinance or some other appropriate and legally binding mechanism:
  - Limit surface disturbance to 30 to 60 percent in the area north of Magee Road, south of the Pima County Line, east of the CAP canal and an alignment that runs approximately ½-mile east of Interstate-10, and west of a line corresponding to the Shannon Road alignment
  - Minimize disturbance to protected desert vegetation
  - Minimize use of non-native or invasive plant species as landscaping (Pygmy-owl Measure - B3).
- The Town will preserve corridors between the preserve and habitat to the south of the preserve. These corridors will, at a minimum, consist of five 300-meter (984-foot) wide corridors centered on the five largest washes crossing Tangerine Road (Pygmy-owl Measure – B4).
- The Town will preserve dispersal corridors across Interstate-10 by requiring establishment of 300-foot buffer along washes with a 100-year discharge greater than 500 cfs (Pygmy-owl Measure – B5).

Burrowing Owl Conservation Strategy

- The Town will prohibit, to the extent possible, development within the floodway of the Santa Cruz River. The Town will discourage those activities within the floodplain which are allowable under current zoning or permitting processes and which, if prohibited, could constitute a taking of property (Burrowing Owl Measure – 1).

4.7.6 Monitoring and Adaptive Management

Since the conservation objectives for pale Townsend's big-eared bats are achieved with implementation of the cactus ferruginous pygmy-owl and burrowing owl conservation strategies, compliance monitoring for Townsend's big-eared bats is encompassed by the compliance monitoring for these two strategies.

Effectiveness monitoring addresses whether the conservation measures are achieving the biological goals and objectives. For pale Townsend's big-eared bats, effectiveness monitoring and adaptive management is not necessary or useful in this HCP. The biological goal for Townsend's big-eared bat is to contribute to maintaining regional populations with

the specific objective of maintaining foraging opportunities. The pygmy owl and burrowing owl conservation strategies will result in the retention of a large amount of potential foraging habitat for Townsend's big-eared bats. Thus, the objective of providing foraging opportunities will be met. Whether and to what degree big-eared bats use foraging habitat in the Town depends on many factors including how far roosts are from the Town and the availability and quality of foraging habitat outside of the Town. These factors are outside of the Town's control. As a result, it would not be possible to determine if a lack of use of habitats in the Town by big-eared bats was because of habitat conditions in the Town or conditions outside of the Town. Further, beyond preserving suitable foraging habitat as under the HCP, it is unlikely that the Town could implement any other actions to provide foraging opportunities for the bats.

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

The pale Townsend's big-eared bat is not known to roost in the Town and no suitable roosting sites are believed to be present. Thus, effects from urban development consist of effects from changes in the availability of potential foraging habitat. Proposed future development in the Town could impact 7,294 acres of potential foraging habitat for pale Townsend's big-eared bats. Although the Town does contain suitable foraging habitat, because known roost sites are farther than the usual foraging distance of these bats (less than 15 miles), the level of use of foraging habitat in the Town by Townsend's big-eared bats is probably limited.

The Town's conservation approach to pale Townsend's big-eared bats is to retain potential foraging habitat. With implementation of the cactus ferruginous pygmy-owl and burrowing owl conservation strategies, foraging habitat for these bats would be conserved. The amount of habitat and to some extent its configuration would depend on which pygmy-owl conservation strategy is implemented. Thus, effects of implementing each of the two pygmy owl conservation strategies in combination with burrowing owl conservation strategy are described individually.

Cactus Ferruginous Pygmy Owl Conservation Strategy A – Section 7-based Approach

The primary measures in Strategy A for pygmy owls that would benefit pale Townsend's big-eared bats are Pygmy-Owl Measure – A1 and Pygmy-Owl Measure – A2. Under Measure A1, the Town would enact an ordinance which would limit surface disturbance to 30 to 60 percent and minimize disturbance to protected desert vegetation. Measure - A2 would further restrict surface disturbance in a portion of the area covered by the ordinance. About 5,035 acres of foraging habitat for big-eared bats occurs in Zone 1 of Measure – A2 in which surface disturbance would be limited to 20 to 30 percent (Figure 4.7-3). Zone 2 of Measure – A2 would encompass 5,478 acres of potential big-eared bat habitat and surface disturbance could be 30 to 60 percent as under the ordinance (Figure 4.7-3). Assuming 30 percent disturbance in Zone 1 and 60 percent disturbance in Zone 2, 6,629 acres of potential foraging habitat for big-eared bats would be retained under this strategy.

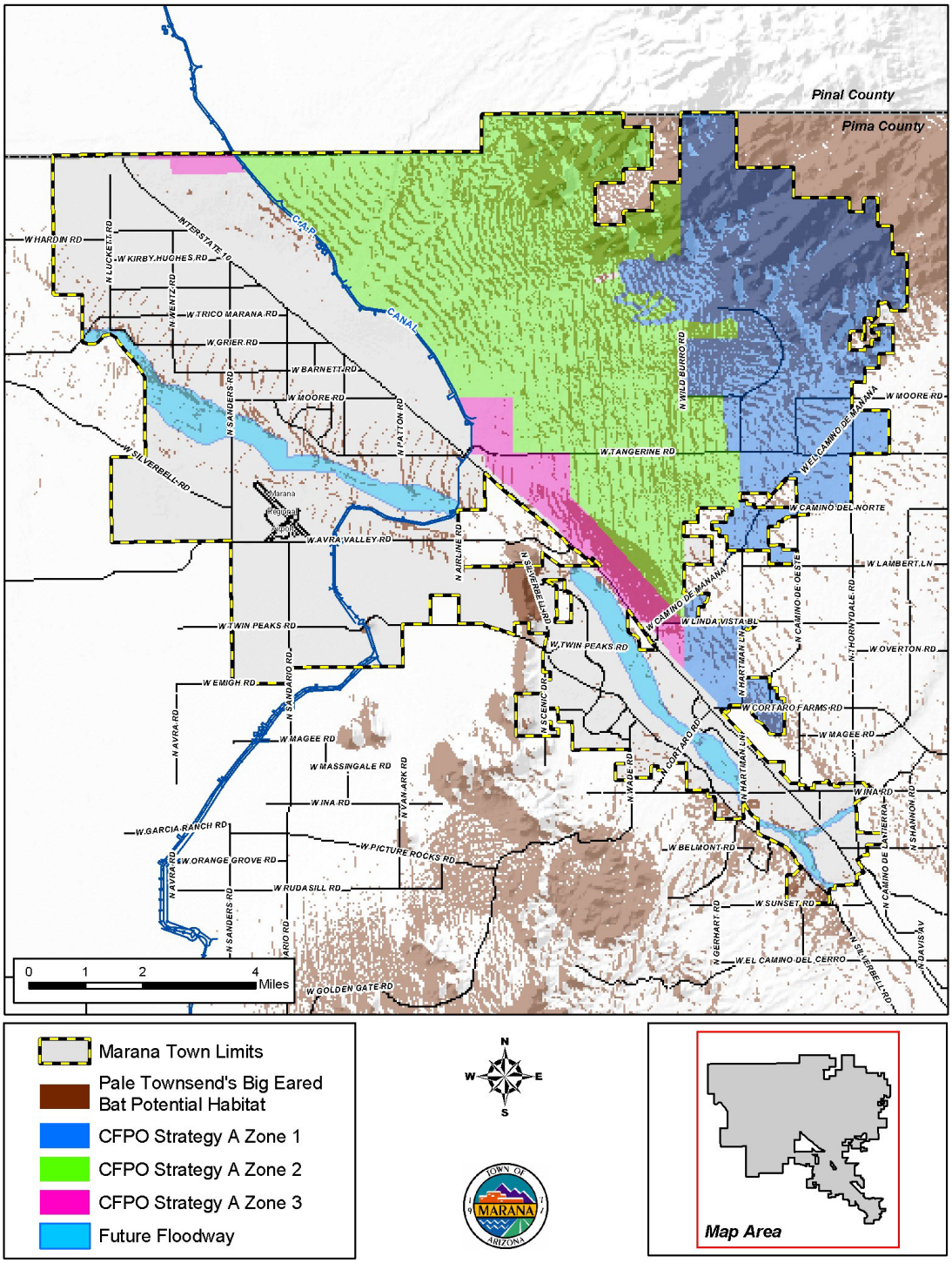

FIGURE 4.7-3
Existing potential habitat for pale Townsend's big-eared bat and proposed zones under CFPO Strategy A.

Under the Burrowing Owl Conservation Strategy, the Town would prohibit development in the Santa Cruz River floodplain (Burrowing Owl – 1). Townsend's big-eared bats often forage along waterways, including riparian and wetland areas. The Town does not control water flow in the Santa Cruz River and therefore cannot guarantee the long term availability of habitat along the Santa Cruz River. However, by prohibiting development in the floodplain, the Town can encourage the long term availability of foraging opportunities along the river to the extent of its authority. Burrowing Owl Measure – 1 would encompass 35 acres of foraging habitat for pale Townsend's big-eared bat. Through implementation of the burrowing owl and pygmy owl conservation strategies (Strategy A) 6,869 acres of potential foraging habitat for Townsend's big-eared bats would be retained in the Town. This acreage represents 60 percent of the total amount of foraging habitat currently supported in the Town. To the extent that pale Townsend's big-eared bats currently forage in the Town, implementation of the HCP would preserve foraging opportunities over the long-term.

Cactus Ferruginous Pygmy Owl Conservation Strategy B – Augmentation Approach

Four of the five measures in Conservation Strategy B for pygmy-owls would benefit pale Townsend' big-eared bats. Under Pygmy Owl Measure - B1, the Town would preserve 18,600 acres of State Trust Lands in the Tortolita fan. Much of the area proposed for preservation provides potential foraging habitat big-eared bats as well (Figure 4.7-4). In addition to habitat in the preserve, the pygmy owl strategy would provide foraging opportunities in many areas outside of the designated preserve. Under Pygmy Owl Measure B3, the Town would implement an ordinance under which surface disturbance would be limited to 30 to 60 percent. Undisturbed areas would be retained in native desert vegetation, thus providing potential foraging opportunities for pale Townsend's big-eared bats. Potential foraging habitat also would be retained in the buffers the Town would require along washes to provide for dispersal across Interstate-10.

The benefits to big-eared bats from the burrowing owl conservation strategy would be the same described above for Pygmy-owl Conservation Strategy A. In combination, floodway restrictions of the burrowing owl conservation strategy and the preserve area of the pygmy owl conservation strategy (Strategy B) would encompass 5,709 acres of habitat for the pale Townsend's big-eared bat (Figure 4.7-4). Outside of these preserve areas surface disturbance would be limited under Measure B3 and would remain in some undeveloped areas. In total, about 9,579 acres of foraging habitat for big-eared bats would remain in the Town. This acreage represents about 84 percent of the total amount of foraging habitat currently supported in the Town. To the extent that pale Townsend's big-eared bats currently forage in the Town, implementation of the HCP would preserve foraging opportunities over the long-term.

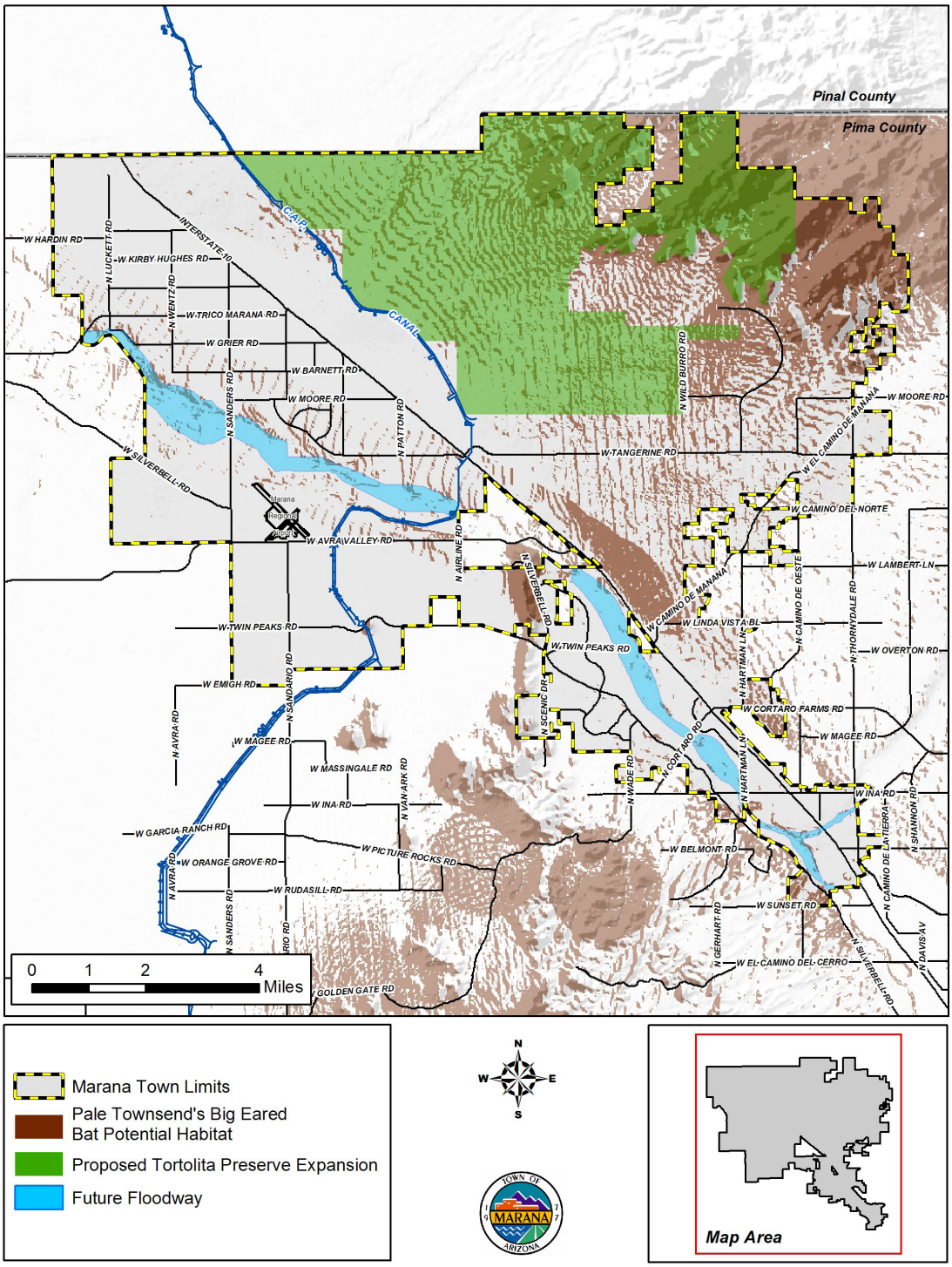

FIGURE 4.7-4
Existing potential habitat for pale Townsend's big-eared bat and proposed Tortolita Preserve Expansion under CFPO Strategy B.

APPENDIX A

Proposed Prohibited Plant Species List

Appendix A: Proposed Prohibited Plant Species List

Fountain grass (*Pennisetum setaceum*)

Buffelgrass (*Pennisteum ciliare*)

Johnson grass (*Sorghum halapense*)

Giant reed (*Arundo donax*)

Common crabgrass (*Digitaria sanguinalis*)

Pampas grass (*Cortaderia selloana*)

Mediterranean grass (*Schismus* spp.)

Red brome (*Bromus rubens*)

Tree of heaven (*Ailanthus altissima*)

African sumac (*Rhus lancea*)

Russian olive (*Eleagnus angustifolia*)

African rue (*Peganum harmala*)

Salt cedar/tamarisk (*Tamarix pertandra* and *T. ramosissima*)

Bermuda grass (*Cynodon dactylon*) excluding sod hybrid *Burmuda*

Lovegrasses (*Eragrostis* spp.) excluding Plains lovegrass (*Eragrostis intermedia*)

Iceplant (*Mesembryanthemem crystallinum*)

Arabian grass (*Schisums arabicus*)

Natal grass (*Melinins* (=*Rhynchelythrum) repens)*

Aquatics

Eurasian watermilfoil (*Myriophyllum spicatum*)

Giant salvinia (*Salvinia molesta*)

Hydrilla (*Hydrilla verticillata*)

Water hyancinth (*Eichhornia crassipes*)

APPENDIX B

Road Design Guidelines

The Pima County Department of Transportation and Flood Control District's **Roadway Design Manual** can be found at: http://www.dot.pima.gov/transeng/roaddesign/

Chapter 4, and in particular, Section 4.7 of this document addresses the Environmentally Sensitive Roadway Design Guidelines that are relevant to the Town of Marana Preliminary Draft Habitat Conservation Plan.