# Chapter 4.0
# Affected Environment

## 4.1 Topography and Geology

### 4.1.1 Introduction

This section characterizes the geologic, soils, a geomorphologic conditions of the El Rio Antiguo study area. The discussion is based primarily on the following technical report, Geotechnical Branch, Geology and Investigations Section, El Rio Antiguo Environmental Restoration Study, Tucson, Arizona, Feasibility F-3 Level Geotechnical Appendix, February, 2002, and is included as Appendix A in this environmental impact statement (EIS).

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### 4.1.2 Environmental Setting

#### 4.1.2.1 Geological Influences on Study Area

**a. Regional Landforms**

Runoff from very nearly all the eastern portions of the Tucson area flows westward to the Santa Cruz River, sooner or later down the Rillito River. Water drains from the south side of the Catalina Mountains (on the north side of the study area), the west side of the Rincon Mountains (to the east of the study area), and part of the northern side of the Santa Rita Mountains to the south of the Tucson Valley). Ultimately, the greatest part of that runoff passes through the study area. In a simplistic way, the Rillito can be seen as the resulting confluence of two smaller drainages, Tanque Verde Wash and Pantano Wash (and they themselves the combination of yet small tributary stream courses) which flows roughly northwest along the feet of the Catalina Mountains across a sedimentary basin.

The steady deposition of sediments eroded from the mountain ranges which encircle the Tucson area on the north (the Catalina Mountains), the east (the Rincon Mountains), and the south (the Santa Rita Mountains) created the valley where Tucson was founded. The study area is on a basin and range valley floor called the Tucson Basin, with surface elevations of

about 2,000 to 3,000 feet, and drainage to the northwest. The Tucson Basin, a north-northwest-trending structural depression, has been filled by deposits 20,000 feet (or more) thick. They are about 65 million years old at their deepest and progressively younger the closer to the present land surface. During the last ice age, the general region was much less desert-like and periodic floods along the southern foot of the Catalinas produced layers of alluvial deposits about 100 feet deep, with the maximum thickness of alluvium along drainage channels. These alluvial sediments form recognizable bands to either side of the current river bottom, with the youngest band (less than 100 years in age) being the river channel deposits themselves. Sediments 12 to 15 thousand years old flank those on both sides of the channel, and beyond those occur sediment between 15 and 130 thousand years in age. The alluvium is composed of sands, gravels, cobbles, silts, and clays. Cementation of these alluvial deposits with calcium-carbonate cement (*caliche*) has occurred in places in the near surface. This type of cementation is a common phenomenon in hot-climate desert environments.

Mountain ranges largely define the Tucson Basin. In addition to the three on the north, east, and south, a smaller range forms the western side of the basin, the Tucson Mountains. The Santa Cruz River flows northward on the western side of the basin, passing west of the Santa Ritas, then east of the Tucson Mountains, and finally west of the Catalinas. Those ranges were impacted by crustal extension and subsequent normal faulting between 30 and 6 million years ago (Pearthree and Biggs 1999). Rocks within these mountain ranges are Precambrian-age metamorphic rocks, with a generally granitic composition, volcanic rocks 65 to 2 million years old, and lesser amounts of limestones and sandstones between 570 and 230 millions years old (USACE 1986:9). These rocks, with few exceptions, are deeply buried in the Tucson Basin. Bedrock does reach the surface in a few places (Pearthree and Biggs 1999), but bedrock is not anticipated to be a factor in any way with regard to this study due to general depth of burial beneath unconsolidated to weakly consolidated, younger sediments. The nearest geologic formations classed as bedrock occur as the Pantano Formation, north of the study area in the foothills of the Santa Catalina Mountains (Fonseca and Melgin 1996:1-9).

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Immediately beneath the riverine and piedmont materials which can be distinguished from each other at the surface and just below it, older sediments that represent the original filling of the Tucson Basin by erosional debris from the surrounding mountain ranges. These older sediments are termed "basin fill" and most sources indicate their age as between 65 and roughly 2 million years. Streams in the Tucson Basin are continuously reworking basin fill materials through erosion and redeposition; three different cycles of this reworking have been interpreted (Hoffman and Ripich, in press). After reworking and redeposition, these sediments are referred to as "valley-fill" materials. Considering the depths of materials and the current concepts and objectives for this study, it is only the "valley-fill" materials that would be dealt with in terms of study-related irrigation, support of constructed plant communities, physical movement of soils, or perhaps construction; none of the basin fill will be impacted. Nevertheless, the basin-fill is important as it is the Tucson Basin's aquifer.

## b. Channel Morphology

In the foreshortened perspective of human life spans, the Rillito River might seem to occupy a fixed place in the landscape. The ages and patterns of different alluvial types contradict this notion. The study area surface and near surface which make up the banks on the south side of the river's channel and contiguous lands farther to the south were formed from river channel and floodplain deposits and terraces that range in age from 10,000 to about 2 million years old. But the river's north bank contains only the youngest deposits of the river channel, floodplain, and terrace sediments less than 10,000 years in age. This is because the Rillito has been migrating northward, eroding what is north of it and depositing reworked sediment to the south. This steady prehistoric movement may possibly still be underway at the same level, and evidently has carried the river's present course nearly to a juxtaposition with piedmont alluvium of the Santa Catalina foothills.

The eye sees now a Rillito River whose modern channel, i.e., its current overall landform, would be in about the same place, but look quite different from that of a century and a half ago. The channel of the Rillito averages 250 feet in width and 4 to 7 feet in depth, but flooding and simultaneous lateral erosion and downcutting have increased widths to as much as 600 feet in places. In historical times, there has been pronounced change in the channel morphology (Pearthree and Baker 1987). In 1858, the Rillito was a continuously vegetated cienega environment with grasses, cottonwood, ash, willow. Beavers dammed it in many places. The floodplain supported grasses, mesquite, four-wing salt bush, and wolfberry. As early as 1872 environmental damage was being done to this environment via overgrazing (Smith 1910). By the 1890s anthropogenic change had substantially altered the channel morphology. It was by that time a wide channel with vertical banks (i.e., an *entrenched* channel system) (Klawon et al. 1999) formed in response to cattle overgrazing, destruction of floodplain grasses, concentration of surface flows into rills and channels, and newly enhanced impact of summer flood flows on this newly erosion-susceptible surface.

Periodic changes of the Rillito's course in more recent times demonstrate that lateral migration of the channel exerts a major role on channel morphology. Pearthree and Baker (1987) discuss a significant role of bank composition in resisting this lateral channel movement via resisting erosion. The contrast is between those banks composed predominantly of sand and banks composed predominantly of silt and clay. Those of silt and clay, with their relatively higher cohesive bonds, require higher water velocities to erode them, so, under identical conditions, the silt-clay banks will resist erosion, while the sand banks will give way and go into suspension. The result is lateral migration of the stream channel, and this migration can be serious, opening zones for flood breakout of flows from the channel confines that may otherwise have been protected. The range of lateral migration within the study area was documented by Pearthree and Baker (1987).

The channel has been straightened in numerous segments (USACE 1986). Straighter channels mean higher flow velocities. Higher flow velocities can result in downcutting of

stream channels, which can be very serious, setting off wide- ranging cycles of erosion on tributaries and damage to infrastructure and environment, including draining of local aquifers and destruction of ecosystems.

Sand and gravel mining formerly took place in the channel, 300 to 800 feet downstream of Campbell Avenue, the downstream extent of the current study area. A study during the first half of 1973, while mining was in progress, noted degradation of the Rillito's stream bed elevation on the average of 0.5 feet at the bridge piers at Campbell. Downcutting of a much more severe nature was noted in the vicinity of sand and gravel mining on Pantano Wash and Tanque Verde Creek (Pearthree and Baker 1987), outside of and upstream of the current study area. It is notable that sand and gravel currently are being mined on the north bank of the river, inside the current study area, but not within the stream channel. Details of that operation were not obtained for the geotechnical appendix.

### c. Stabilized Banks

The newest significant impact on channel morphology of the Rillito is soil-cement bank stabilization for flood-control purposes. As of 1984, soil-cement protection had been added to selected, discontinuous locations on both banks. This protection, designed to contain the 100-year-flood within its banks in all the study area except the "bend" and the "northwest" area, totaled 26,500 linear ft as of 1984 and was primarily the work of Pima County Transportation and Flood Control District (PDTFCD). Of that protection, 9,060 linear ft was within the study area, all confined to the "bend" area (USACE, 1986, figs. 5a, 5b). In the early-to-mid 1990's, more soil-cement erosion-control was added to the Rillito's banks within the study area by PDTFCD and the US Army Corps of Engineers: between the N. Campbell Avenue crossing, eastward to Country Club Road, a distance of about 1 mile, which was part of an overall 13.2 mi of planned soil-cement stabilization (PFCD, 1991, p. 5). This construction ultimately was designed to protect the incised, steep river banks from erosion, and to restore them to pre-1983 flood condition.

More than 95% of the river's banks have been coated with soil cement (Fig. 4.1-1). In total, thirteen gaps occur between Craycroft and Campbell Roads. Most are simply places where a small wash enters the main channel. By structural necessity the bank hardening turns into each a wash and extends upstream for a short distance before giving way to the natural bank, in effect making each wash's mouth a stabilized entry way for water to flow from adjacent overbank lands into the main river bottom. Six of these occur on the north bank. Progressing downstream from Craycroft Road they are: Craycroft Wash (draining 3.07 square miles), Flecha Caida Wash (1.47 square miles watershed), Valley View Wash (4.11 $mi^2$), Finger Rock Wash (6.09 $mi^2$), Camino Real Wash (1.86 $mi^2$), and Campbell Wash (2.50 $mi^2$ of drainage area). Three washes drain higher lands south of the Rillito: (downstream from Craycroft) an unnamed wash (less than a quarter square mile of drainage area), Alamo Wash (the largest, at 9.90 $mi^2$), Alvernon Wash (3.32 $mi^2$), and Christmas Wash (also 3.32 $mi^2$).

The largest unprotected section occurs on the south bank at the northern end of Columbus Boulevard (Fig. 4.1-1). A length of approximately 2500 feet on this portion of the south

bank has no hardened surface. The second longest stretch without soil cement occurs on the other side of the river bottom and slightly upstream, where approximately 400 feet of bank on the north side of the river is unprotected. This short segment exists where Flecha Caida Wash reaches the Rillito, across the river bottom and somewhat to the east of Columbus Road (Fig. 4.1-1). Short gaps in the soil cement on both banks exist at Dodge Bridge, and a second pair of gaps (through both banks) occurs about 1500 feet upstream from that point. None of these four coincides with the mouth of a wash of any size.

Scattered segments of Pantano and Tanque Verde Washes have also been stabilized by soil cement. Downstream from Campbell Road, stabilized banks extend almost continuously to the Santa Cruz River, with short gaps at a few places along the water course and stopping about half a mile east of Interstate 10. Figure 4.1-1 encompasses a limited region of the Rillito's drainage, so cannot portray the relative amount of soil cement within the study area compared to all that now exists throughout the watershed.

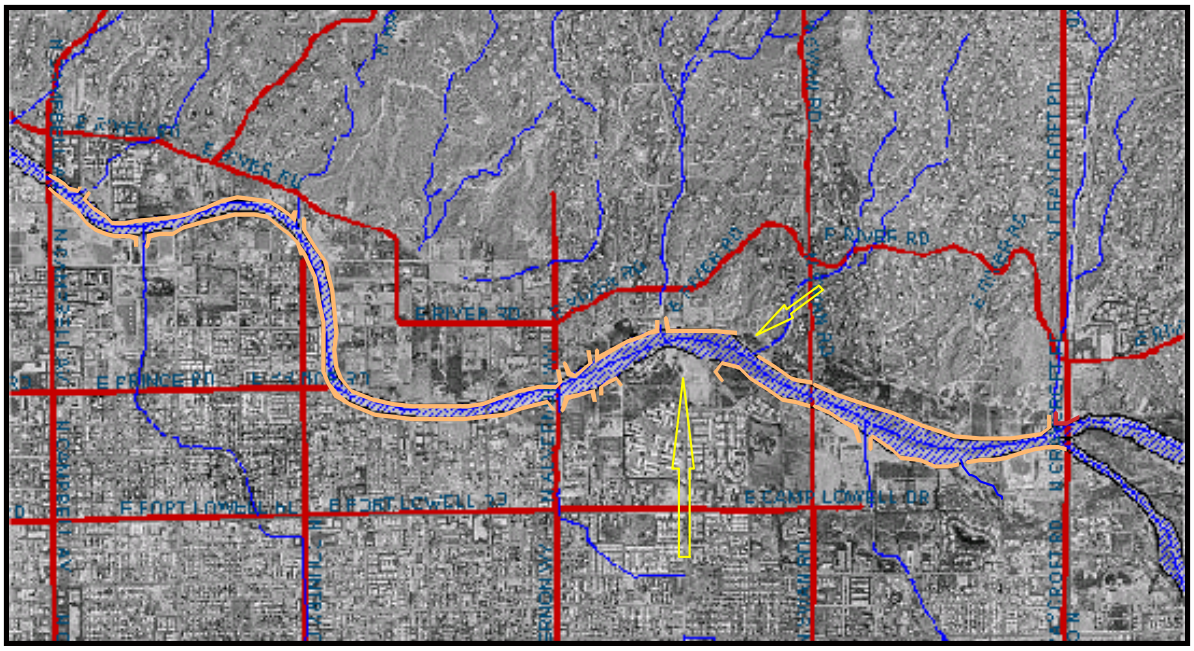


**Fig. 4.1-1.** Portions of the Rillito River stabilized by soil cement (shown in orange) between Craycroft and Campbell Roads. Gaps are exaggerated merely to be visible. Yellow arrows denoted the two biggest gaps, at Columbus Bouelvard and Flecha Caida Wash. Red lines are major roads in the study area, and blue lines denote washes.

## d. Soil Characteristics in the Study Area

**Soil Types.** The utility of local soils for accomplishing this study's environmental restoration goals are tied to groundwater levels and the high permeability of the uppermost soils. The soil groupings shown on Figure 4.1-2 are summarized below:

- River wash (Rv) consists of loose sandy, gravelly, and stony material. It is so coarse, loose, and leachy that it does not support plant growth.

- Rough (R) consists of steep, rough, and badly eroded areas. They consist of very gravelly or stony material and have developed little or no soil profile and does not support plant growth.

- Gila (Gs, Gv, Gm, Gl, Gf, Gd, and Gc) soils. The Gm and Gc designations of this soil are finer and better suited to retaining moisture. The Gs, Gv, Gl, Gf, and Gd designations could require irrigation. These soils support native plant species.

- Pinal (Py) soils. These soils retain moisture and support native plant species.

- Mohave (Mo) soils. These soils retain moisture and support native plant species.

- Laveen (Li and Ls) soils. These soils retain moisture and support native plant species.

- Anthony (Al) soils. These soils retain moisture and support native plant species. Though these soils are variable in their moisture retaining ability.

- Tucson (Tl) soils. These soils retain moisture and support native plant species.

- Cajon (Ca) soils. These soils do not retain moisture.

- Comoro (Cs) soils. These soils retain a low amount of moisture though they do support native plant species

- Pima (Pc) soils. These soils retain moisture and support native plant species.

Two other factors impact a soil's ability to support plant growth. Both of these factors vary between soil classifications and can vary within each soil classification. The first factor is the amount of organic material in the soil. The second factor is whether or not calcium carbonate cementation is present in the soil and the degree of calcium carbonate cementation that exist in the soil. Soils in which the calcium carbonate cementation is continuous do not allow for root growth and do not retain water.

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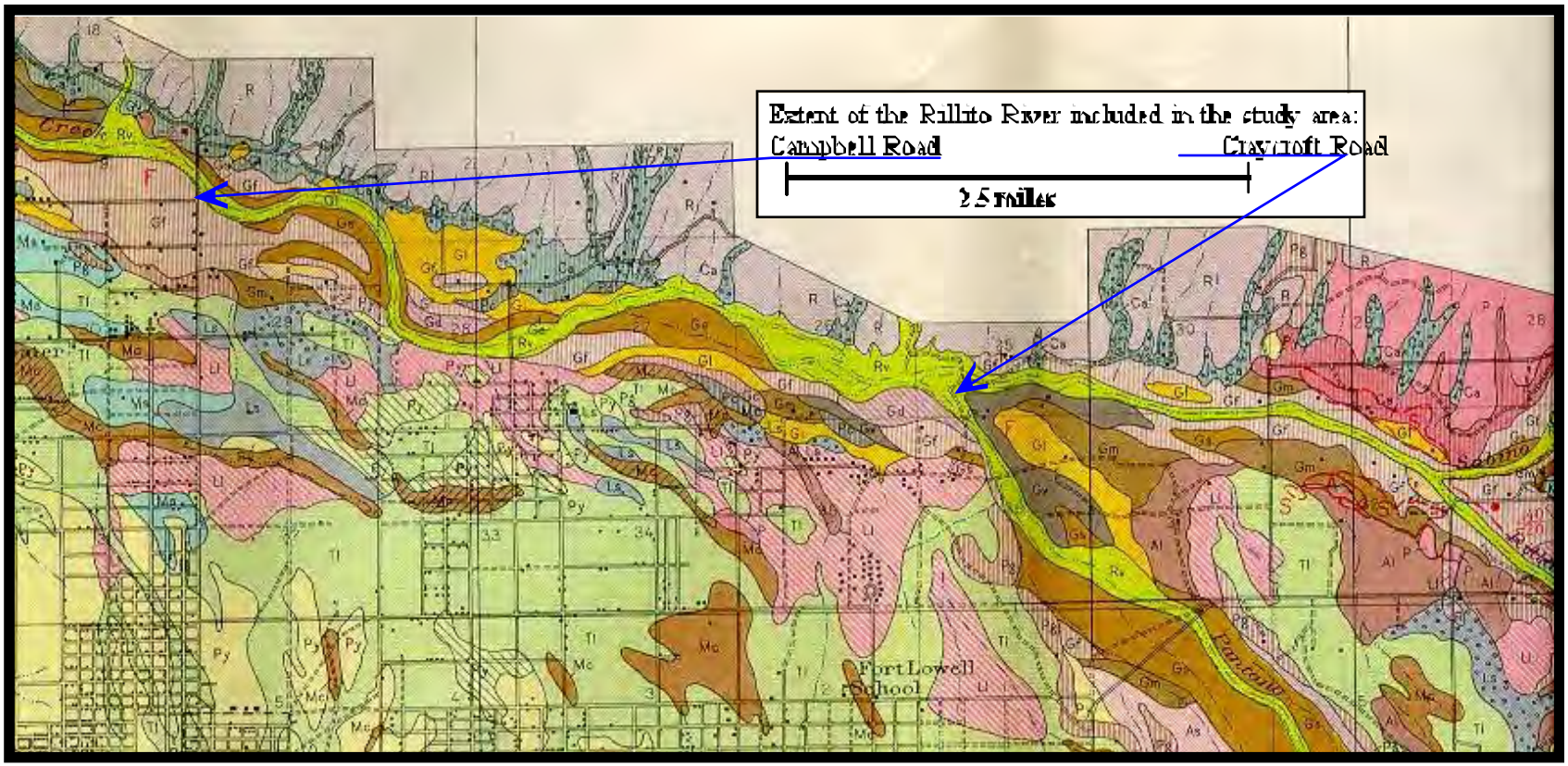


**Fig. 4.1-2**; (adapted from the accompanying Geotechnical Appendix, and derived from the map of Youngs, *et al*., 1931 [Soil Survey of the Tucson Area, Arizona, US Dep. Agriculture, Bureau of Chemistry and Soils, and University of Arizona Agricultural Experiment Station, soils map]). Soil types extant along the Rillito River channel and adjacent lands within the study area.

Soils (as per cited source): 1) Those soils in the river are "Rv" = River wash; "Gs" = Gila fine sand; "Gv" = Gila very fine sandy loam; "Gm" = Gila silt loam; "Gl" = Gila loam; " Gf" = Gila fine sandy loam; "Gd" = "Gila loamy fine sand"; 2) those soils south of the river are "Gc" = Gila silty clay loam; "Py" = Pinal silty loam (hachured is deep phase); "Mc" = Mohave loam (hachured is dark-colored phase); "Ll" = Laveen loam, "Ls" = Laveen sandy loam; Al = Anthony loam; Tl = Tucson loam; 3) those soils north of the river are "Ca" = Cajon sand; "Cs" = Comoro sandy loam (gravelly-subsoil phase); "Pc" = Pima silty clay loam; "R" = rough, broken and stony land Red lines = areas moderately affected by alkali; red dots = soils borings sites with % conc. alkali in surface foot listed on top and avg. % alkali in top 6 ft listed on bottom.

# 4.1.3 References

U.S. Army Corps of Engineers
2002 El Rio Antiguo Environmental Restoration Study, Tucson , AZ, Feasibility F-3 Level Geotechnical Appendix. Los Angeles District Engineering Division, Geotechnical Branch, Geology and Investigations Section. February.

Pearthree and Biggs 1999, 1987
USACE 1986
Fonseca and Melgin, 1996, p. 1-9
Hoffman and Ripich, in press
Smith 1910
Klawon et al. 1999
PFCD 1991:5

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# 4.2 Hydrology

## 4.2.1 Introduction

This section characterizes the hydrology and water quality conditions of the El Rio Antiguo study area. The information discussed below is based primarily on three reports, El Rio Antiguo Rillito River Environmental Restoration Documentation for Hydrologic Studies, El Rio Antiguo Rillito River Environmental Restoration Documentation for Hydraulic Studies, and El Rio Antiguo Rillito River Restoration Documentation for Groundwater Studies. These reports are included as Appendices B, C and D, respectively, and should be reviewed for detailed information on hydrology and water quality.

## 4.2.2 Environmental Setting

The Rillito River is a major watercourse that runs primarily east to west along the edge of the Santa Catalina Mountain Foothills in Pima County, Arizona. This watercourse flows ephemerally, mainly during the months of July, August, and September, as a result of monsoon thunderstorms. Climate is typical of the Sonoran Desert, semi-arid, characterized by long hot summers and short mild winters. The Rillito River is a sand bed channel with sand depth as much as 12 feet in places. Channel widths range between 300 and 400 feet. Areas adjacent to the Rillito River consist of heavily vegetated areas, as well as undeveloped desert shrub, and typical urban development. In response to historic flood events, such as record floods in October 1983 and January 1993, almost all segments of the Rillito River have been channelized or bank stabilized.

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### 4.2.2.1 Groundwater

Periodic streamflow occurs in the Rillito River in response to precipitation and snowmelt from the Santa Catalina and Rincon Mountains. The hydrogeologic system is characterized by this ephemeral streamflow and subsequent recharge. Infiltration occurs through the highly permeable stream-channel deposits. Groundwater flows down gradient to the south-southwest through moderately to highly permeable basin-fill deposits. Groundwater flow continues along the ephemeral stream channel of Rillito River and eventually discharges to municipality wells south and west of the study.

The underlying aquifer system consists of basin-fill deposits of alluvial sediments underlain by crystalline rocks. The main aquifer is the Fort Lowell Formation, which is moderately to highly permeable. Highly permeable stream-channel deposits, that have the ability to be saturated, are an important feature that enhances and facilitates the water flow to recharge the aquifer. While this highly permeable stream-channel deposits

enhance recharge to the aquifer, they decrease the actual flow of water through the stream channel.

A major factor affecting the streamflow in Rillito River is loss due to channel infiltration. Estimates indicate that approximately half of the incoming runoff from the tributaries through the Rillito River is lost to infiltration into the streambed. There is approximately 5,100 to 6,800 acre-feet of annual runoff from Rillito River to the Santa Cruz River that could be a potential source of recharge. The more water that is infiltrated through the streambed deposits, eventually flowing as groundwater to the aquifer, the less water there is to actually flow through the Rillito River.

### 4.2.2.2 Reclaimed Water

Reclaimed water is secondary effluent wastewater that receives additional treatment. Reclaimed water is suitable for irrigation, industrial uses, and groundwater recharge. The Tucson Water Department delivers reclaimed water to the City Department of Parks and Recreation as well as private users. The primary use of this reclaimed water is turf irrigation; however, it is also available for recharge.

Reclaimed water use in the El Rio Antiguo study area is used by Davidson Elementary School, McCormick Park, Whitmore Elementary School, the Tucson Medical Center, Fort Lowell Park, and St. Gregory's School, primarily for turf irrigation. The reclaimed water comes from the Roger Road Water Reclamation Facility, located approximately nine miles west of the study area along the Santa Cruz River. The reclamation facility treats sewage from the metropolitan area of Tucson.

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### 4.2.2.3 Water Quality

Water quality samples in the study area reveal that certain organic and inorganic constituents occur in some wells. Some constituents, such as nitrates, toluene, organic compounds, and sulfonamides, occur at concentrations that may be potentially harmful to public health.

### 4.2.2.4 Hydrology

The Rillito River drainage area is bounded on the north by the Santa Catalina Mountains, on the east by the Tanque Verde, Rincon, and Whetstone Mountains, on the south by the Empire Mountains and Canelo Hills, and on the west by the Santa Rita Mountains. Between the mountain ranges, there are some low divides where the drainage boundary is indistinct. Elevations vary from 2,300 feet mean sea level (MSL) at the confluence of the Rillito River and Santa Cruz River to 9500 feet MSL at Mount Wrightson in the Santa Rita Mountains. The gradient of the channel ranges from about 300 feet per mile in the headwaters to about 20 feet per mile at the confluence. In general, development is sparse, except in the Tucson metropolitan area.

Basically, there is no streamflow except during and immediately following relatively heavy precipitation. This is due in part because climatic and drainage area characteristics are not conducive to continuous runoff. Because of steep gradients, streamflow in the mountains increases rapidly in response to high-intensity precipitation and causes debris-laden flash floods to debouch onto the valley plains below. The velocities and peaks are reduced, the debris is deposited, and a considerable amount of flow is lost to streambed percolation. Vegetation has a negligible effect on flood runoff, except where perennial grasses impede overland flow in the upper areas, such as that of Pantano Wash.

The Rillito River drainage area has experienced major storms and floods. For years, the largest flood on record for the Rillito River was that of September 1929, when a peak discharge of 24,000 cubic feet per second was measured. Currently, the largest one on record is that of October 1983 when peak discharge reached 29,700 cfs.

### 4.2.2.5 Hydraulics

The main factors affecting hydraulics are the consistency of the coarse sand bed and the variation in vegetation along the channel. This includes overbank areas of vegetation and other obstructions to water flow. In general, overbank areas within the study area are more vegetated than the lower reach of the Rillito west of the study area. In particular, vegetation growth was notable in the river channel at Country Club Road, and at Dodge Boulevard Bridge. For a detailed hydraulic analysis, please refer to Appendix C.

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In the El Rio Antiguo study area, the banks of the Rillito River have been stabilized with soil cement protection. Grade control structure has also been constructed, mostly by the bridges, to help stabilize the channel bed. Because the channel is stabilized, hydraulic analysis focused on average annual deposition and scour depths. This means that significant quantities of sediment can be transported by more frequent water flow events throughout the year, not just high flow events that typically occur only once a year. Hydraulic analysis is discussed in detail in Appendix C.

### 4.2.2.6 Floodplain

Both banks of the Rillito in the project reach have been stabilized with soil cement up to the existing bank elevation or the 100-year water surface elevation, whichever is lower. As a result, the estimated 50-year flood event flow is contained within stabilized banks along most of the study reach, with minor overflows at only a few short segments (mainly in the bend area between Country Club Road and Alvernon Way alignments). The 100-year flow is contained within banks along a major portion of the study reach, with substantial overflows occurring on the south bank in the bend area and minor breakouts in several other places. As expected, the 500-year flow event causes major overflows along both banks of almost the entire project reach.

## 4.2.3 Regulatory Setting

This section describes a few of the local federal and local agencies and jurisdictions as well as a few local ordinances that are applicable to hydrology issues.

U.S. Army Corps of Engineers

U.S. Bureau of Reclamation

Federal Flood Insurance Program

Clean Water Act

National Pollutant Discharge Elimination System Discharge Permits

Safe Drinking Water Act

Arizona Game and Fish Commission

Pima County Department of Transportation and Flood Control

Pima County Floodplain and Erosion Hazard Management Ordinance

Pima County Riparian Habitat Protection and Mitigation Requirements

Pima County Native Plant Preservation Ordinance

City of Tucson Native Plant Preservation Ordinance

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## 4.2.4 References

Pima County Department of Transportation and Flood Control District

2002 El Rio Antiguo Rillito River Environmental Restoration Documentation for Hydrologic Studies. Prepared for USACE. Flood Control Engineering Division. March.

2002 El Rio Antiguo Rillito River Environmental Restoration Documentation for Hydraulic Studies. Prepared for USACE. Flood Control Engineering Division. March.

2002 El Rio Antiguo Rillito River Restoration Documentation for Groundwater Studies. Prepared for USACE. Flood Control Engineering Division. March.

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# 4.3 Biological Resources

## 4.3.1 Introduction

This chapter summarizes the existing biological resources of the El Rio Antiguo study area. The study area includes approximately four miles of the Rillito River and adjacent floodplain between Craycroft and Campbell Roads in northern Tucson (Figure 4.3-1). The northern boundary of the study area is adjacent to the foothills of the Santa Catalina Mountains. The east, west, and south boundaries of the study area are adjacent to commercial and residential buildings.

An area on the south bank of the Rillito River became the subject of a different type of feasibility analysis by the Corps in 1999. This area lies entirely inside the designated limits of this El Rio Feasibility Study. Congressional appropriations mediated through the Water Resources Development Act permit the Corps to engage with local cost-sharing sponsors in comparatively small habitat restoration projects. This area is the subject of one such project, termed an 1135 under the Continuing Authorities Program. It is known officially as the Rillito/Swan Wetlands 1135 Habitat Restoration Project. Pima County Transportation and Flood Control District solicited this work as the formal local sponsor.

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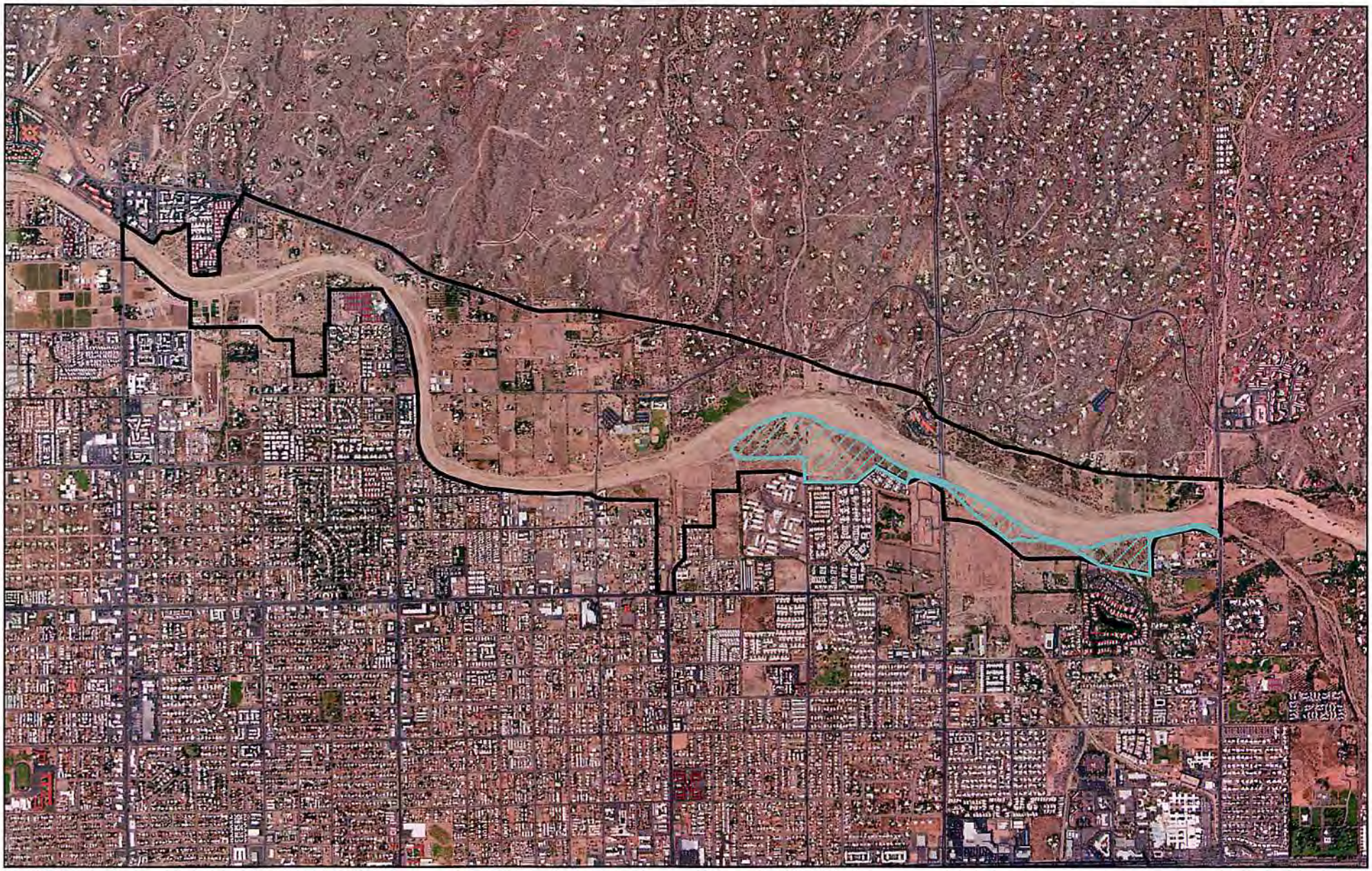
The site occupies degraded lands centered primarily at the northern end of Columbus Road (see Figure 4.3-1). In total, it covers approximately 64 acres. The eastern part happens to be long and thin in several places and was shaped that way to fit property owned by the sponsor. The bulk of the project, roughly 60 acres, is centered at Columbus, but in its entirety does extend nearly to Craycroft Road.

The existence of this prior 1135 effort creates a minor accounting awkwardness for the El Rio Feasibility Study in that environmental benefits expected to accrue must not be counted twice. Therefore, all aspects of the Rillito/Swan 1135 project area will be disregarded for this current analysis. Existing biotic conditions will not be described, nor will they be tallied. In effect, this portion of the Rillito's south bank will simply be ignored altogether.

A general biological resources survey of the El Rio Antiguo study area was conducted on February 19, 2002 by RECON biologists Jennifer Hodge and Fred Edwards. Vegetation communities were assessed and mapped onto 1 inch equals 400 feet aerial photos, flown in October 1999. A geographic information system (GIS) data layer of biotic communities mapped during the development of the Sonoran Desert Conservation Plan was used and revised as deemed appropriate in the field. Animal species observed directly or detected from calls, tracks, scat, nests, or other sign were noted. All plant species observed on-site were also noted, and plants that could not be identified in the field were identified later using taxonomic keys. Limitations to the compilation of a



RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

Study area

Swan Wetlands, UCACE 1135 project

0 Mile 0.5

# FIGURE 4.3-1

**Aerial Photograph of El Rio Antiguo Study Area and Swan Wetlands**

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comprehensive floral checklist were imposed by seasonal factors, since spring annuals may have not been apparent at the time of the survey. Because surveys were performed during the day, nocturnal animals were identified by sign.

Vegetation community and floral nomenclature follows Brown, Lowe, and Pase (1994), Hickman (1993) and Epple (1995). Zoological nomenclature for birds is in accordance with the American Ornithologists' Union Checklist (1998); for amphibians, Collins (1997); for butterflies, Opler and Wright (1999); and for mammals, Jones et al. (1997). Assessments for the sensitivity of species are based on Sonoran Desert Conservation Plan information, the Arizona Game and Fish Department (AGFD) (1996a, 1998a, 2000) and the U.S. Fish and Wildlife Service (USFWS) (2001).

## 4.3.2 Environmental Setting

### 4.3.2.1 Regional and Historic Biological Resources

The Tucson area is situated in a high desert valley surrounded by four mountain ranges: the Santa Catalina Mountains to the north, the Santa Rita Mountains to the south, the Rincon Mountains to the east, and the Tucson Mountains to the west. The Tucson watershed and associated habitat has been significantly altered in the past one hundred years. Historically, many of the rivers flowed perennially and supported lush riparian vegetation and marsh habitat, including the Rillito. Prior to 1890, dense stands of cottonwood, willow, ash, and walnut trees lined a the narrow Rillito River and mesquite bosques covered the floodplain terraces. Beaver dams, which helped to create backwater areas, were common (Pima County 1999). It is estimated that 85 to 95 percent of quality riparian habitat in Pima County has been lost over the past century.

Riparian systems provide important habitat for a wide variety of plants and animals. This is especially important in the Southwest where the upland habitats are typically dry and devoid of rich vegetation. Migratory songbirds, such as warblers and thrushes, depend upon riparian areas for foraging and breeding areas. These strings of habitat, while encompassing less than one percent of the Southwest landscape, support a disproportionately high number of wildlife species. Riparian areas also provide habitat for small mammals, lizards, snakes, and invertebrates, which in turn are preyed upon by larger mammals, birds, and bats. It is estimated that 75 to 90 percent of all wildlife in the arid southwest is riparian dependent during some part of its life cycle (Pima County 1999). Riparian corridors allow wildlife to safely travel between areas. Degradation or loss of riparian habitat within Pima County has had great impacts on most resident species.

Historically, the Pantano Wash, Santa Cruz River, Cienega Creek, and the Rillito River provided these islands of habitat in the Tucson Basin needed to support resident and migratory wildlife species. Human uses, such as agriculture, livestock grazing,

groundwater pumping, and urbanization have depleted the groundwater in the Tucson watershed and reduced available riparian habitat. The remaining riparian habitat in the Tucson area, while degraded, continues to provide habitat for a wide range of species. Increasing the amount of available foraging and breeding habitat is essential to the survival of some listed species, such as the southwestern willow flycatcher and cactus ferruginous pygmy-owl.

### 4.3.2.2 Local Biological Resources

The Rillito River is formed at the confluence of Pantano Wash and Tanque Verde Creek, which flows from the Rincon Mountains. Pantano Wash is formed at the confluence of Rincon Creek and Cienega Creek in the southeastern Tucson area. The Rillito, which is now an ephemeral watercouse, continues west of the study area joining with the Santa Cruz River approximately 12 miles downstream. There are many washes that flow into the Rillito along the study area. Washes descending from the Santa Catalina Mountains through the foothills are generally undisturbed, whereas the washes flowing into the Rillito from the south through the Tucson metropolitan area have been channelized and cemented. Washes that empty into the Rillito River along the study site include Campbell, Camino Real, Finger Rock, Valley View, Flecha Caida, and Craycroft washes along the north, and Christmas, Alvernon, and Alamo washes along the south. Throughout the entire length of the study area, soil cement has been placed on the north and south banks of the Rillito to control urban flood damage. The U.S. Army Corps of Engineers (USACE) completed the Rillito River Bank Protection Project, which in addition to stabilizing the banks, constructed paved and gravel pedestrian trails along the river that are heavily used by the public for walking, biking, and jogging. The paved trail on the north bank west of Craycroft Road is shown in Photograph 4.3-1.

Draft

Elevation in the study area ranges from 2,328 feet above mean sea level (MSL) in the streambed to approximately 2,400 feet MSL on the north side of the river in the Santa Catalina foothills.

### 4.3.2.3 Quantifying of Biological Resources

In simplistic terms, the study area of this feasibility analysis encompasses the broad bottom of an intermittent river; its immediate banks; small washes more typical in their shape, size, substrate characteristics, and biological inhabitants of the Sonoran Desert; and older, stabilized depositional terraces. A few of the washes traverse these older terraces. Other terraces are merely overbank floodplains created in a geological timescale but now effectively isolated from further geological aggradation and degradation by bank stabilization methods already in place along virtually the entire length of the study area.

Biotic resources, whether plant communities or individuals of species, inherently follow these riverine patterns. Accounting for the worth of biological resources will entail

PHOTOGRAPH 4.3-1

**Paved trail west of Craycroft Road on the north bank of the Rillito River**

PHOTOGRAPH 4.3-2

**Mesquite bosque disturbed by urbanization**

RECON

methods to characterize why the biotic patterns appear as they do within the study area, rather than merely describing in a static manner existing conditions. This feasibility study will rely on results of hydrogeomorphic functional analysis (termed HGM analysis) to yield quantitative descriptions of biological resources along and adjacent to the Rillito River.

An HGM approach treats the biota of an area as being the outcome of well-defined and understood ecological process. It also merges these biological events with hydrologic and geologic process at work in a region. Hence, the HGM results attempt to explore the reasons why organisms live where we find them within the study area. The methodology also yields quantified assessments of how extensive the biological resources actually are, in a manner similar to that often used and called a modified habitat evaluation.

Details of the numeric formulations and ecological relationships they attempt to model are presented in the accompanying HGM appendix.

## 4.3.2.4 Existing Conditions

### a. Soils

Draft

Seven soil series and classifications are present within the El Rio Antiguo study area and are depicted in Figure 4.3-2. Arizo-Riverwash Complex 0-3 percent slopes and Glendale silt loam 0-3 percent slopes compose approximately 90 percent of the project area including nearly all of the river floodplain and adjacent upland areas. Other soil types on-site are confined to the edges of the project boundary and have already been developed. These include Anthony fine sandy loam, Pinaleno-Stagecoach complex, Pinaleno-Stagecoach-Palosverdes complex, Pits and dumps, and Sahuarita-Mohave-Urban land. The Arizo-Riverwash Complex and Glendale soil series are described below.

**Arizo-Riverwash Complex.** This soil complex is a mixture of Arizo and Riverwash soils. Arizo soils are deep, excessively drained, gravelly fine sands that are formed in mixed alluvium and generally found on recent alluvial fans, stream terraces, and floodplains of intermittent streams or channels. Riverwash, which also occurs in intermittent stream channels, is typically sandy, gravelly, or cobbly. It is excessively drained and rapidly permeable.

**Glendale.** Glendale soils consist of deep, well-drained soils formed in stratified alluvium and are encountered on alluvial fans, floodplains, and stream terraces. The landscape where Glendale soils are encountered generally slope from 0 to 5 percent.

### b. Vegetation Communities

Vegetation in the El Rio Antiguo study area has decreased significantly. Habitat now occurs as sparse remnants of communities that once dominated the landscape. Vegetation

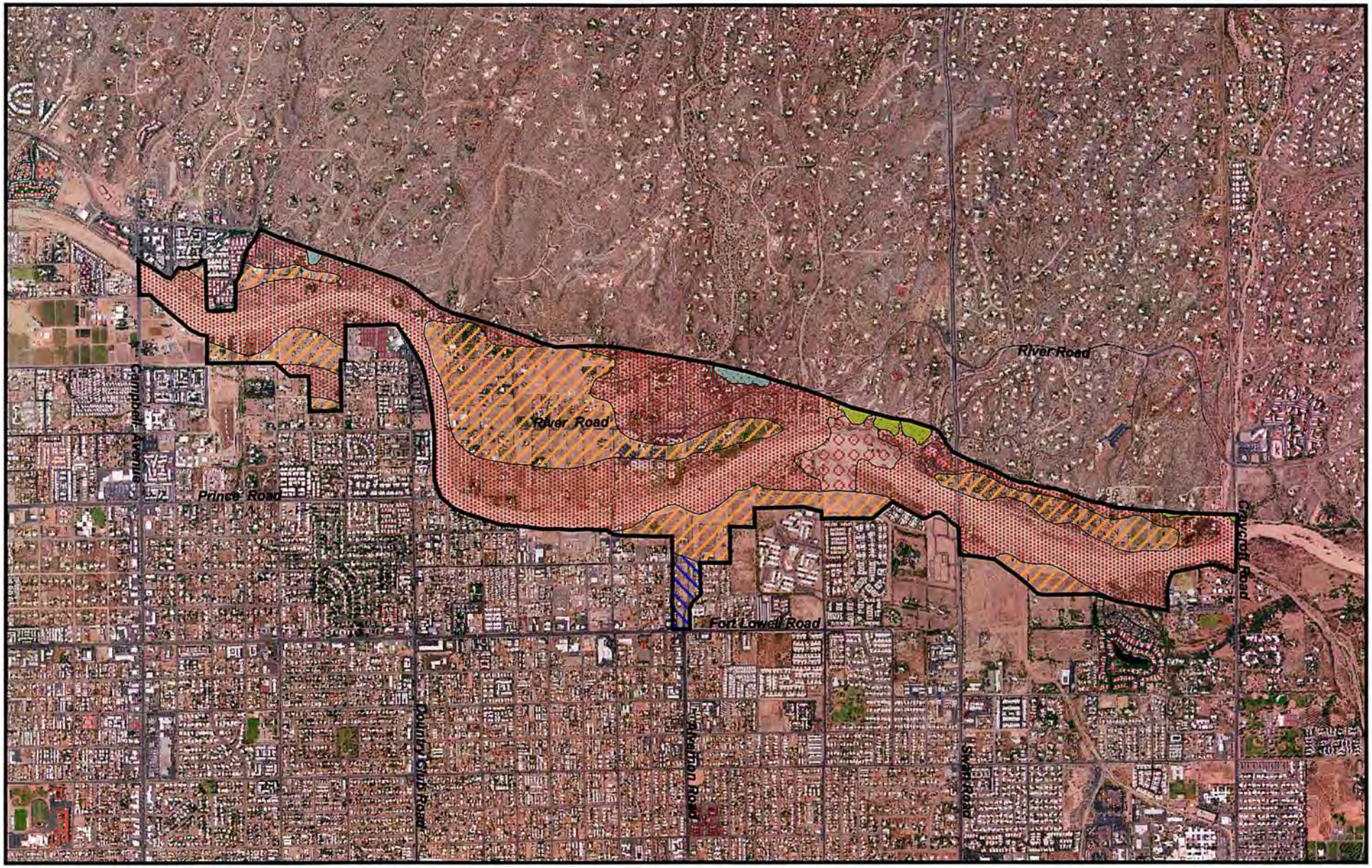


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Image Source: 2001 AirPhotoUSA (flown October 1999)

Study area

0 Mile 0.5

Soils (Source: USDA-NRCS 1999)

- Anthony fine sandy loam, 0 to 3 percent slopes
- Arizo-riverwash complex, 0 to 3 percent slopes
- Glendale silt loam, 0 to 3 percent slopes
- Pinaleno-stagecoach complex, 5 to 16 percent slopes
- Pinaleno-stagecoach-palos verdes complex, 10 to 35 percent slopes
- Sahuarita soils, mohave soils and urban land, 1 to 5 percent slopes
- Pits, dumps

# FIGURE 4.3-2

## Soils within the Study Area

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communities present within the El Rio Antiguo study area include Sonoran desert scrub, mesquite bosque, Sonoran deciduous swamp and riparian scrubland and Sonoran interior strand habitat. Vegetation communities were mapped based on the Brown, Lowe, and Pase (1994) vegetation classification system. Because these communities are generally discontinuous and have been altered so significantly, they were difficult to classify based on present conditions. For example, dense stands of cottonwood-willows have given way to a few remaining cottonwoods within a larger landscape of more shrub and scrub species. These areas have been classified as Sonoran deciduous swamp and riparian scrubland. Urban/developed and disturbed areas dominate the survey area. Soil cement banks and paved and gravel trails occur on the north and south side of the river and traverse a variety of habitat types, predominantly they are mapped within the Sonoran interior strand habitat.

Riparian-dependent plant communities, such as riparian scrub, strand, and mesquite bosques, are considered sensitive vegetation communities in the Southwest, including Pima County. These riparian communities have been impacted by diversion of and reduction in stream flow, the depletion of groundwater tables, competition by exotic plant species, the effects of grazing and fire, and loss of floodplain function by undercutting caused by flood control activities, and encroaching urban and agricultural uses (Pima County 2000; Fonseca 2001).

Draft

Vegetation communities are described below, summarized in Table 4.3-1, and depicted in Figure 4.3-3. The numbers preceding each habitat title corresponds to the vegetation classification codes in Brown, Lowe, and Pase (1994). A list of plant species observed is presented in Table 4.3-2.

**TABLE 4.3-1**
**VEGETATION COMMUNITIES**

| Vegetation Community | Acreage |
|---|---|
| Sonoran Desert Scrub, Paloverde – Mixed Cacti Series (154.12) | 53.1 |
| Sonoran Riparian and Oasis Forests, Mesquite Series (224.52) | 91.0 |
| Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series (234.71) | 31.7 |
| Sonoran Interior Strand, Mixed Scrub Series (254.71) | 120.3 |
| Current Low Flow Channel (999.41) | 62.7 |
| Developed (999.21) | 771.5 |
| TOTAL ACREAGE | 1,130.3 |

*Numbers in parentheses correspond to vegetation classification codes from Brown, Lowe and Pase 1994.

**154.12-Sonoran Desert Scrub, Paloverde-Mixed Cacti Series (53.1 acres).** This habitat association is a major component of the Arizona Upland Subdivision as defined

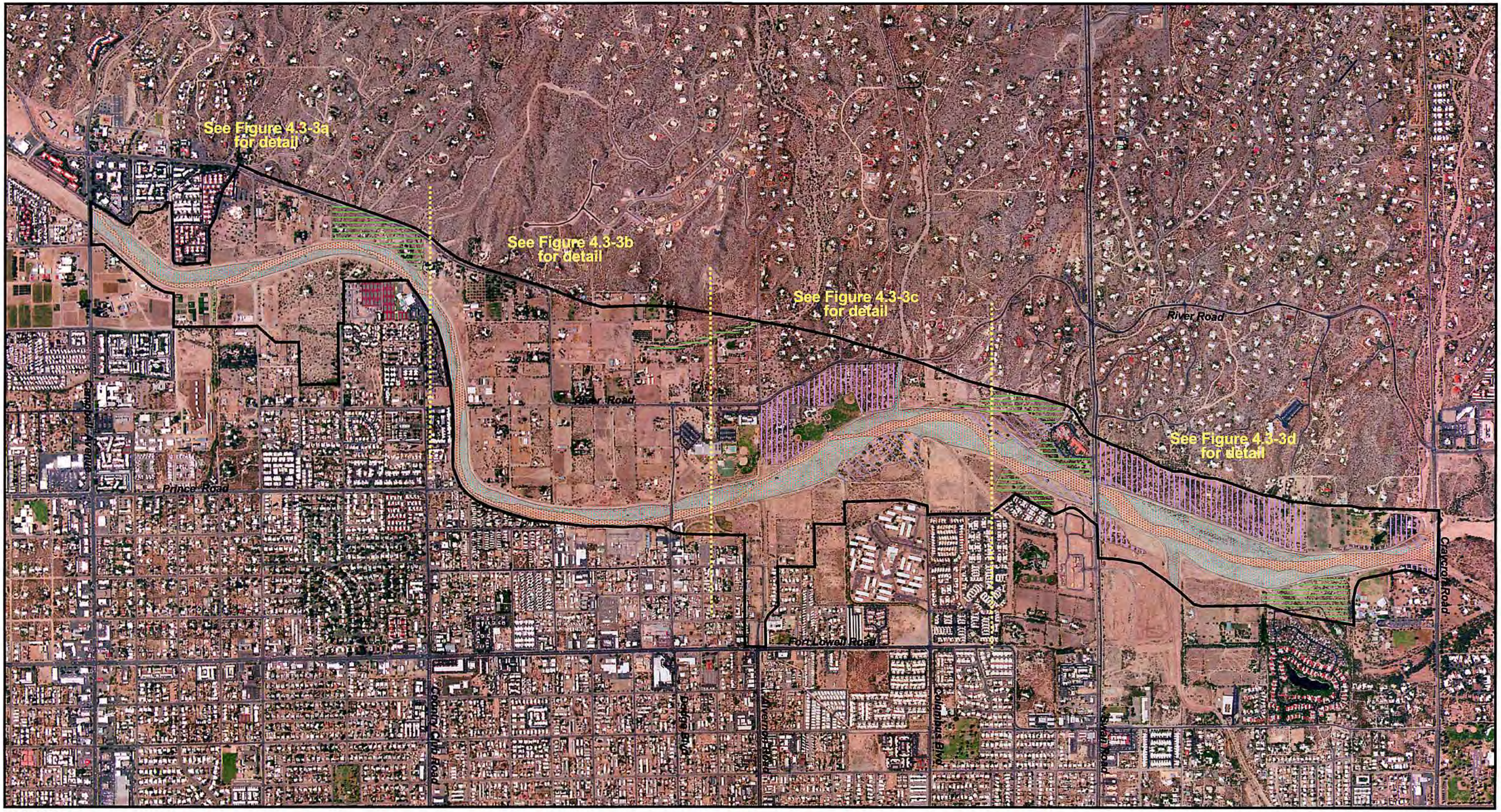


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Image Source: 2001 AirPhotoUSA (flown October 1999)

0 Feet 1500

Study area

Vegetation Communities (BLP Code)

- Sonoran desert scrub, paloverde-mixed cacti series (154.12)
- Sonoran riparian and oasis forests, mesquite series (224.52)
- Sonoran deciduous swamp and riparian scrub, mixed scrub series (234.71)
- Sonoran interior strand, mixed scrub series (254.71)
- Current Low Flow Channel
- Developed

# FIGURE 4.3-3

**Vegetation Communities, Overview**

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RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

0 Feet 475

Study area
Matchline

Vegetation Communities (BLP Code)
Paloverde-mixed cacti (154.12)
Sonoran interior strand (254.70)

Current Low Flow Channel
Developed

FIGURE 4.3-3a

**Vegetation Communities**

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RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

Study area
Matchline

0 Feet 475

Vegetation Communities (BLP Code)
Paloverde-mixed cacti (154.12)
Sonoran interior strand (254.70)

Current Low Flow Channel
Developed

FIGURE 4.3-3b

**Vegetation Communities**

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RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

Study area
Matchline

Vegetation Communities (BLP Code)
Paloverde-mixed cacti (154.12)
Mesquite (224.52)
Sonoran deciduous swamp and riparian scrub (234.70)
Sonoran interior strand (254.70)

Current Low Flow Channel
Developed

0 Feet 475

FIGURE 4.3-3c

**Vegetation Communities**

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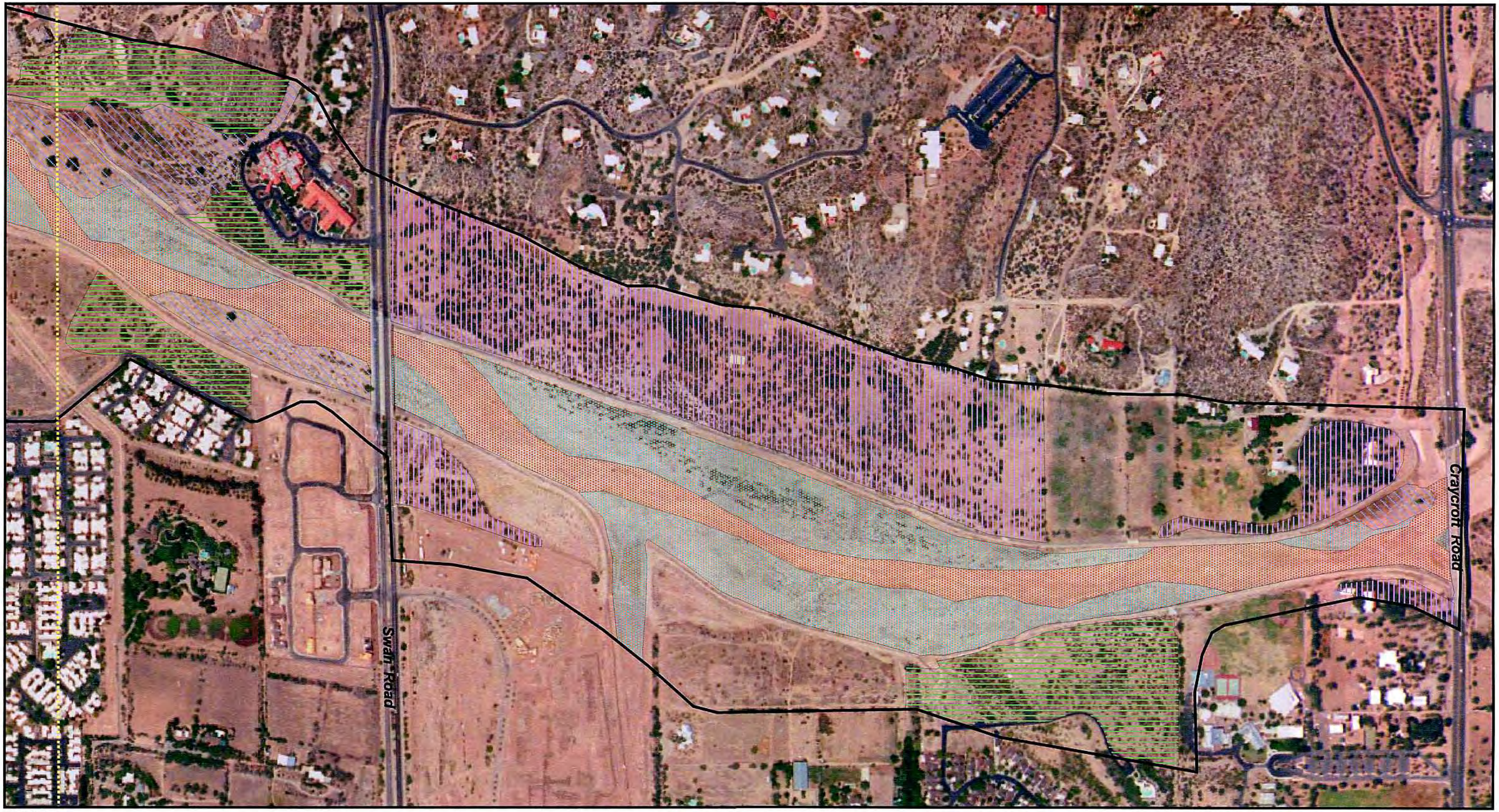


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Image Source: 2001 AirPhotoUSA (flown October 1999)

0 Feet 475

Study area
Matchline

Vegetation Communities (BLP Code)
Paloverde-mixed cacti (154.12)
Mesquite (224.52)
Sonoran deciduous swamp and riparian scrub (234.70)
Sonoran interior strand (254.70)

Current Low Flow Channel
Developed

FIGURE 4.3-3d

**Vegetation Communities**

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**TABLE 4.3-2**
**PLANT SPECIES OBSERVED WITHIN THE EL RIO ANTIGUO STUDY AREA**

| Scientific Name | Common Name | Habitat | Status | Origin |
|---|---|---|---|---|
| *Acacia constricta* Benth. | White-thorn acacia | M | | N |
| *Ambrosia ambrosioides* Cav. | Canyon ragweed | S | | N |
| *Ambrosia deltoides* Torr. | Triangle bursage | S | | N |
| *Arundo donax* L. | Giant reed | S | | I |
| *Atriplex canescens* (Parsh) Nutt. | Four-wing saltbush, shad-scale | M | | N |
| *Baccharis salicifolia* (Ruiz Lopez & Pavón) Pers. | Seep willow | S, R | | N |
| *Baccharis sarothroides* A. Gray | Desert broom | S,R,D | | N |
| *Carnegiea gigantea* (Engelm.) Britt. & Rose (*Cereus giganteus* Engelm.). | Saguaro | P | PNP | N |
| *Cassia covesii* | Desert senna | | | N |
| *Celtis pallida* Torr. | Desert hackberry | M | PNP | N |
| *Cercidium floridium* Benth. | Blue paloverde | P | | N |
| *Cercidium microphyllum* (Torrey) Rose & I.M. Johnson | Yellow (foothill) paloverde | P | | N |
| *Chilopsis linearis* var. *arcuata* (Fosb.) Henrickson | Western desert willow | S,R,M | PNP | N |
| *Cirsium* sp. | Thistle | M,D | | I |
| *Cynodon dactylon* (L.) Pers. | Bermuda grass | M,S | | I |
| *Elaeagnus angustifolia* L. | Russian olive | D | | I |
| *Encelia farinosa* Torrey & A. Gray | Brittlebush, incienso | D | | N |
| *Eragrostis lehmanniana* | Lehman's lovegrass | S | | N |
| *Erigeron* sp. | Fleabane | S | | N |
| *Eriogonum* sp. | Annual buckwheat | S | | N |
| *Eriogonum fasciculatum* Benth. | Buckwheat | D | | N |
| *Erioneuron* sp. | Fluff grass | M,D | | N |
| *Erodium* sp. | Filaree | D | | I |
| *Eucalyptus* spp. | Eucalyptus | D | | I |
| *Ferocactus wislizenii* (Engelm.) Brit. & Rose | Arizona fishhook barrel cactus | P | PNP | N |
| *Gutierrezia sarothrae* (Pursh) Britt. & Rusby. | Broom snakeweed, matchweed | S | | N |
| *Heterotheca grandiflora* Nutt. | Telegraph weed | D,M | | I |
| *Hilaria rigida* (Thurb.) Benth. | Hilaria | M,S,R | | N |
| *Hymenocloa monogyra* A. Gray | Burrobrush | S,R | | N |
| *Isocoma tenuisecta* Greene | Burroweed | S | | N |
| *Larrea tridentata* (DC.) Cov. | Creosote bush | P, M | | N |
| *Lycium* sp. | Lycium | M | | I/N |
| *Marrubium vulgare* L. | Horehound | M,S,R | | N |

**TABLE 4.3-2**
**PLANT SPECIES OBSERVED WITHIN THE EL RIO ANTIGUO STUDY AREA**
**(continued)**

| Scientific Name | Common Name | Habitat | Status | Origin |
|---|---|---|---|---|
| *Mentzelia sp.* | Desert blazing star | | | N |
| *Nicotiana glauca* Grah Grah. | Tree tobacco | S,R | | I |
| *Opuntia* sp. | Cholla | P | | N |
| *Opuntia bigelovii* Engelm. | Jumping cholla, teddy bear cholla | P | | N |
| *Phoradendron californicum* Nutt. | Desert mistletoe | M | | N |
| *Plantago insularis* Eastw. | Plantain | M,D | | N |
| *Polypogon monspeliensis* (L.) Desf. | Annual beard grass | S, R | | I |
| *Populus fremontii* Wats. Ssp. *fremontii* | Fremont cottonwood, alamo | R | | N |
| *Prosopis glandulosa* Torrey var. *toreyana* (L. Benson) | Western honey mesquite | M,D | | N |
| *Prosopis velutina* Wooton | Velvet mesquite | M, P | PNP | N |
| *Psorothamnus spinosus* A. Gray | Smoke tree | S,R | | N |
| *Salsola tragus* L. | Russian thistle, tumbleweed | D,S | | I |
| *Sambucus mexicana* C. Presl | Blue elderberry | M,R | | N |
| *Sisymbrium irio* L. | London rockets | M,D | | I |
| *Sphaeralcea ambigua* Gray. | Desert globemallow | M,D | | N |
| *Sporobolus airoides* (Torrey) Torrey | Alkali sacaton | S | | N |
| *Tamarix chinensis* Lour. | Salt cedar | S,R | | I |
| *Washingtonia filifera* Wendl. | California palm | D | | I |
| *Xanthium strumarium* L. | Rough cocklebur | M,S | | N |
| *Zizyphus obtusifolia* (Torrey & A. Gray) A. Gray var. *canescens* (A. Gray) M. Johnston | Graythorn, lotebush | M | | N |

HABITATS

D = Developed
M = Sonoran Riparian and Oasis Forests, Mesquite Series
R = Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series
S = Sonoran Interior Strand, Mixed Scrub Series
P = Sonoran Desert Scrub, Paloverde-Mixed Cacti Series

OTHER TERMS

N = Native to locality
I = Introduced species from outside locality

STATUS

PNP= Pima County Protected Native Plant Species

by Brown, Lowe, and Pase and is commonly known as Paloverde-Cacti desert. The Arizona Upland Subdivision includes the higher regions of Phoenix and Tucson that have cooler average temperatures and high rainfall. The Paloverde-Cacti biotic community is characterized by scrubland or low woodland of leguminous trees with intervening open areas that are stratified by one to several layers of shrubs and perennial succulents (Brown et al. 1994). Common to bajadas (gentle slopes) and mountain foothills, this habitat is characterized by paloverde (*Cercidium* spp.), creosote (*Larrea tridentata*), mesquite (*Prosopis* spp.), and cacti. Locally, any of these plant species can be numerically dominant (Brown et al. 1994).

This community was mapped within some of the washes and on the south side of the river west of Craycroft Road, generally within the urban landscape. The paloverde-mixed cacti habitat in the study area is dominated by yellow paloverde (*Cercidium microphyllum*) and velvet mesquite (*Prosopis velutina*) with an understory of shrub and cactus species, including creosote bush, saguaro (*Carnegeia gigantea*), and cholla (*Opuntia* spp.). The groundcover is sparse due to habitat disturbance from urbanization, recreation, and possibly, grazing. Grasses such as hilaria are present. Desert broom (*Baccharis sarothroides*), a native species typical of disturbed areas, is a dominant shrub in the larger patches of habitat on the river terraces.

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**224.52-Sonoran Riparian Deciduous Forest, Mesquite Series (91.0 acres).** Mesquite forests are winter deciduous habitats that are largely restricted to immediate floodplains of perennial or spring-flowing streams where they are maintained by winter-spring flooding. Commonly known as mesquite "bosques" these forests reach maximum development on alluvium of old dissected floodplains at the convergence of major watercourses and their tributaries (Brown et al. 1994). The interior of mesquite bosques are characteristically open with an herbaceous understory of annual and perennial grasses such as vine mesquite (*Panicum obrosum*), forbs, and saltbushes (*Atriplex* spp.).

Approximately 91 acres of mesquite bosque are present along the terrace of the Rillito River, all of which have been disturbed by grazing and/or urbanization. Photograph 4.3-2 depicts the typical disturbed mesquite bosque in the survey area. Note that few shrubs or understory species occur among the mesquite. Scattered shrubs, such as desert hackberry (*Celtis pallida*) and western desert willow (*Chilopsis linearis* var. *arcuata*), and ground cover grasses, such as the non-native Bermuda grass (*Cynodon dactylon*), are found within this community. The remnant bosques in the survey area are disconnected from the river channel by the presence of the soil cement banks installed during the bank stabilization project. The installation of these banks and urbanization has decreased the functionality of the mesquite bosque.

**234.71-Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series (31.7 acres).** Sonoran deciduous swamps and riparian scrublands are found in and along drainages in the desert region. This community is found in flood-prone areas susceptible

to scouring, but is generally more developed than the Sonoran interior strand habitat in the study area.

On the El Rio Antiguo project site, Sonoran riparian scrubland is dominated by burrobrush (*Hymenoclea monogyra*). The habitat differs from the adjacent strand community (see below) by the presence of mature shrubs and trees. Velvet mesquite, desert willow, and salt cedar (*Tamarix chinensis*) are apparent. Cottonwood (*Populus fremontii*) trees are scattered throughout this scrub community on-site and are possible indicators of where the mature cottonwood-willow communities historically occurred on the Rillito River. Approximately three acres of remnant cottonwoods have been mapped within the riparian scrubland. One patch of riparian scrub, which includes a few cottonwood trees along the south bank west of the Swan Road Bridge, is shown in Photograph 4.3-3.

**254.71-Sonoran Interior Strand, Mixed Scrub Series (120.3 acres).** Sonoran interior strands, or vegetation within stream channels, typically support open stands of scrub, shrubs, and weeds. Wetter sites may support more herbaceous species, such as cocklebur (*Xanthium strumarium*) and rabbit's foot grass (*Polypogon monspeliensis*). The strand community is determined by the fluctuations of water level and scouring by flood events. It is similar in composition to the Sonoran riparian scrubland, but is less developed due to more frequent scouring.

Draft

The majority of the vegetation within the Rillito River is mapped as Sonoran interior strand, which consists mainly of early successional subshrub vegetation. Patches of vegetation, dominated by burrobrush, were found along the higher margins of the Rillito, outside of the low flow channel. A representative depiction of this community is provided in Photograph 4.3-4. This photograph was taken from the north bank between Country Club Road and Campbell Road. Other species observed include desert willow, desert broom, seep willow (*Baccharis salicifolia*), salt cedar, Lehman's lovegrass (*Eragrostis lehmanniana*), and annuals such as buckwheat (*Eriogonum* sp.), cocklebur, Russian thistle (*Salsola tragus*), desert senna (*Cassia covesii*), and desert blazing star (*Mentzelia* sp.).

**999.41-Current Low Flow Channel (62.7 acres).** The current low flow channel is mapped to provide a "snapshot" of the current conditions. The low flow channel and the strand communities are dynamic; their locations fluctuate depending upon the amount of rainfall and flood occurrences, which scour the vegetation and carve the main channel.

**999.21-Developed (732.4 acres).** The developed areas within the El Rio Antiguo study area consist of baseball fields, urban parks, roads and residential, and commercial buildings.

PHOTOGRAPH 4.3-3

**Sonoran deciduous swamp and riparian scrubland community west of Swan Road**

**Note the cottonwood trees in this scrub community**

PHOTOGRAPH 4.3-4

**Representative Sonoran interior strand community within the Rillito River**

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## c. Zoology

Species detected during the surveys are typical of the desert vegetation communities in the region. A complete list of the wildlife species detected on-site is provided in Table 4.3-3.

**Mammals**. Naturally vegetated areas provide cover and foraging opportunities for a variety of desert mammal species. Dense riparian vegetation, of which the Rillito is generally lacking, provides roosting trees for bats. Most desert mammals are nocturnal or crepuscular.

One mammal species common to creosote communities, the Harris' antelope squirrel (*Ammospermophilus harrisii*), was observed on-site. Other species with the potential to occur include desert cottontail (*Sylvilagus audubonii*), deer mouse (*Peromyscus maniculatus*), and striped skunk (*Mephitis mephitis*). Bats have been observed at the bridge that crosses the Rillito River on Campbell Avenue (L. Woods, personal communication, 2001). Mexican free-tailed bats (*Tadarida brasiliensis*) are known to roost in other bridges in Tucson and could possibly be roosting in any of the bridges in the survey area. Other bat species potentially occurring include big brown bat (*Eptesicus fuscus*), Yuma myotis (*Myotis yumanensis*), and pocketed free-tailed bats (*Tadarida femorosaccus*).

draft

**Birds.** The diversity of bird species within an area varies with respect to the character, quality, and diversity of the vegetation communities present. The low to moderate quality habitat associated with the El Rio Antiguo site presently, precludes a high diversity of species using the site. Many birds common to urban areas were observed.

Birds commonly observed on-site in the Paloverde-mixed cacti desert habitat include permanent residents such as curve-billed thrasher (*Toxostoma curvirostre*), Gila woodpecker (*Melanerpes uropygialis*), cactus wren (*Campylorhynchus brunneicapillus*), common raven (*Corvus corax*), canyon towhee (*Pipilo fuscus*), and wintering residents such as yellow-rumped warbler (*Dendroica coronata*).

Gambel's quail (*Callipepla gambelli*) and white-crowned sparrows (*Zonotrichia leucophrys*) were commonly observed in the streambed. Resident species observed in the mesquite bosques and surrounding areas include phainopepla (*Phainopepla nitens*), vermilion flycatcher (*Pyrocephalus rubinus*), black phoebe (*Sayornis nigricans*), and lesser goldfinch (*Carduelis psaltria*).

Birds adapted to urban areas observed include European starling, house finch (*Carpodacus mexicanus*), house sparrow, mourning dove, and rock dove. These species were mostly observed in the developed areas and associated non-native landscapes.

**TABLE 4.3-3**
**WILDLIFE SPECIES DETECTED ON THE EL RIO ANTIGUO STUDY AREA**

| Common Name | Scientific Name | Occupied Habitat | Evidence of Occurrence |
|---|---|---|---|
| Butterflies (Nomenclature from Opler and Wright 1999) | | | |
| Common or checkered white | *Pieris protodice* | M | O |
| Sulfur | *Colias* sp. | S, R | O |
| West coast lady | *Vanessa annabella* | S | O |
| Reptiles (Collins 1997) | | | |
| Side-blotched lizard | *Uta stansburiana* | M | O |
| Birds (Nomenclature from American Ornithologists' Union) | | | |
| Northern harrier | *Circus cyaneus* | F | O |
| Red-tailed hawk | *Buteo jamaicensis* | F | O |
| American kestrel | *Falco sparverius* | F | O |
| Killdeer | *Charadrius vociferus* | S | O |
| Mourning dove | *Zenaida macroura* | D,M | O |
| Rock dove | *Columbia livia* | D,M | O |
| Greater roadrunner | *Geococcyx californianus* | P,D | O |
| Anna's hummingbird | *Calypte anna* | M,D,R | O |
| Gila woodpecker | *Melanerpes uropygialis* | M,D | O |
| Vermilion flycatcher | *Pyrocephalus rubinus* | M | O |
| Cactus wren | *Campylorhynchus brunneicapillus* | M,R,D | O |
| Bewick's wren | *Thyromanes bewickii* | M | O |
| Northern mockingbird | *Mimus polyglottos* | M,D | O |
| Curve-billed thrasher | *Toxostoma curvirostre* | M | O |
| Phainopepla | *Phainopepla nitens* | M,D | O |
| Lesser goldfinch | *Carduelis psaltria* | M,R,D | O |
| House finch | *Carpodacus mexicanus* | M,R,D,S | O |
| Lark sparrow | *Chondestes grammacus* | D | O |
| White-crowned sparrow | *Zonotrichia leucophrys* | D,M | O |
| Great-tailed grackle | *Quiscalus mexicanus* | D,M | O |
| European starling* | *Sturnus vulgaris* | D,M | O |
| House sparrow * | *Passer domesticus* | D,M | O |

**TABLE 4.3-3**
**WILDLIFE SPECIES OBSERVED AND KNOWN TO OCCUR ON EL RIO ANTIGUO PROJECT SITE**
**(continued)**

| Common Name | Scientific Name | Occupied Habitat | Evidence of Occurrence |
|---|---|---|---|
| Mammals (Nomenclature from Jones et al. 1982) | | | |
| Harris' antelope squirrel | *Ammospermophilus harrisii* | S | |

*Introduced species.

Habitats
D =Developed
M =Sonoran Riparian and Oasis Forests, Mesquite Series
R =Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series
S =Sonoran Interior Strand, Mixed Scrub Series
P =Sonoran Desert Scrub, Paloverde-Mixed Cacti Series
F =Flying overhead

Evidence of Occurrence
O = Observed

Sensitivity Status
SDCP = Priority Vulnerable Species, Sonoran Desert Conservation Plan
WC = Wildlife of Special Concern, Arizona Department of Game and Fish

**Reptiles.** The diversity and abundance of reptile species vary with habitat type. Many reptiles are restricted to certain vegetation communities and soil types, although some of these species will also forage in adjacent communities.

A side-blotched lizard (*Uta stansburiana*) was detected on-site. Tree lizards (*Urosaurus ornatus*) and the eastern fence lizard (*Sceloporus undulates*) may also occur on-site.

**Amphibians.** All amphibians require moisture for at least a portion of their lifecycle, with many requiring a permanent water source for habitat and reproduction. Terrestrial amphibians are adapted to more arid conditions and are not completely dependent on a perennial or standing source of water.

No amphibians were detected on-site. The ephemeral nature of the Rillito likely precludes amphibians from inhabiting the site.

**Butterflies.** Butterfly distribution is generally defined by the distribution of their larval food plant and habitat type. Species common to desert riparian habitat, desert scrub, and disturbed areas are expected to be the most common butterfly species on-site. In the springtime, a higher butterfly diversity is expected.

Butterfly species observed on-site include west coast lady (*Vanessa annabella*), checkered white (*Pieris protodice*), and sulfurs (*Colias* sp.).

Draft

## 4.3.2.5 Sensitive Biological Resources

Species are considered sensitive or rare if they meet one or more of the following criteria: (1) the species is listed or proposed for listing as threatened or endangered under the federal Endangered Species Act, (2) is a U.S. Fish and Wildlife species of special concern, (3) is a Arizona Game and Fish Department species of special concern, (4) is recognized as a SDCP priority vulnerable species, or (5) is a Pima County protected native plant. Species that meet these criteria and are known to occur on the El Rio Antiguo study area, or potentially may occur, are discussed below.

### a. Sensitive Plants

Sensitive plant species that could potentially occur on-site and are known to occur in the vicinity are listed in Table 4.3-4 and corresponding sensitivity codes are defined in Table 4.3-5. Four sensitive plant species were observed on the El Rio Antiguo project site and these are discussed below. No federal or state listed plant species were observed.

**Desert hackberry (*Celtis pallida*).** Desert hackberry is a Pima County Protected Native Plant. A spiny, evergreen shrub in the Elm family (Ulmaceae), desert hackberry has dark green elliptical or oval leaves that can be toothed or untoothed with spines up to one inch

**TABLE 4.3-4**
**SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA**

| Species | Status | Habitat | Occurrence/Comments |
|---|---|---|---|
| Sensitive Plants | | | |
| Catclaw acacia<br>*Acacia greggii* | PNP | Slopes, canyons, desert washes, streams, and grasslands below 5,000 feet. | Potential to occur in the mesquite communities. |
| Desert hackberry†<br>*Celtis pallida* | PNP | Washes, canyons, and open desert between 1,500 and 3,500 feet. | Observed in the study area. |
| Netleaf hackberry<br>*Celtis reticulata* | PNP | Moist soils near streams, in canyons; upper desert at 1,500 feet to oak woodland at 6,000 feet. | Potential to occur. |
| Western desert willow†<br>*Chilopsis linearis* var. *arcuata.* | PNP | Washes and waterways in desert foothills and grasslands; 1,500 to 5,000 feet | Occurs throughout the riparian scrub and strand communities. |
| Acuna cactus<br>*Echinomastus erectocentrus* var. *acunensis* | FC, PNP, SDCP, HS, USFS, BLM | Well-drained knolls and gravel ridges between major washes; 1,300 to 2,00O feet. | Study area is outside of Acuna cactus elevation range. Not expected to occur due to disturbed nature of upland habitat. |
| Arizona fishhook barrel cactus†<br>*Ferocactus wislinzenii* | PNP | Sandy, gravelly soils in desert grasslands; 1,000 to 4,500 feet. | Observed in the desert scrub community. |
| Huachuca water umbel<br>*Lilaeopsis schaffneriana* ssp. *recurvata* | FE, SDCP, USFS, HS,* | Sites with perennial water, gentle stream gradients, moderately sized drainage areas, and mild winters. | Not expected to occur due to lack of perennial flow and suitable habitat. |
| Velvet mesquite†<br>*Prosopis velutina* | PNP | Desert washes and streams; high groundwater; below 5,000 feet. | Observed in the mesquite and Paloverde-cacti communities. |
| Tumamoc globeberry<br>*Tumamoca macdougalii* | SDCP, SR, USFS, BLM | Under the shade of trees in desert scrub, mesquite, ironwood, paloverde; undisturbed soil between 2,000 and 2,680 feet. | Not expected to occur due to limited distribution and disturbed nature of site. |

**TABLE 4.3-4**
**SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA**
**(continued)**

| Species | Status | Habitat | Occurrence/Comments |
|---|---|---|---|
| Fish (Nomenclature from Lee et. al 1980) | | | |
| Longfin dace<br>*Agosia chrysogaster* | FSC, SDCP | Cool mountain streams to small intermittent low-desert streams; sand or gravel. | Not expected to occur due to lack of stream flow. |
| Gila chub<br>*Gila intermedia* | FC, WC, SDCP | Headwater streams, cienegas, springs and marshes of the Gila River basin. | Not expected to occur due to lack of stream flow. |
| Desert sucker<br>*Catostomus clarki* | FSC, SDCP | Rapids, flowing pools of streams; gravel rubble and sandy silt. | Not expected to occur due to lack of stream flow. |
| Sonora sucker<br>*Catostomus insignis* | FSC, SDCP | Lentic and pool habitats in rivers and streams; gravel-rubble bottoms. | Not expected to occur due to lack of stream flow. |
| Desert pupfish<br>*Cyprinodon macularius macularius* | FE, WC, SDCP, USFS | Water bodies with a broad range of temperatures and salinities. | Not expected to occur due to lack of stream flow. |
| Gila topminnow<br>*Poeciliopsis occidentalis occidentalis* | FE, WC, SDCP, USFS | Permanent water ranging from headwater streams to brackish marshes. | Not expected to occur due to lack of permanent stream flow. |
| Amphibians (Nomenclature from Collins 1997) | | | |
| Lowland leopard frog<br>*Rana yavapaiensis* | FSC, SDCP, USFS, BLM, * | Restricted to permanent waters south and west of Mogollon Rim, below 5,500 feet. | Not expected to occur due to lack of permanent waters. Study area identified as critical landscape linkage. |
| Reptiles (Nomenclature from Collins 1997) | | | |
| Desert box turtle<br>*Terrapene ornata luteola* | SDCP | Arid and semi-arid treeless plains with rolling grass, and shrubland with sandy soils. | Study area identified by SDCP as having low to medium habitat potential for this species. Currently, not expected to occur due to lack of suitable habitat. |

**TABLE 4.3-4**
**SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA**
**(continued)**

| Species | Status | Habitat | Occurrence/Comments |
|---|---|---|---|
| Giant spotted whiptail<br>*Cnemidophorus burti strictogrammus* | FSC, USFS, BLM, SDCP | Dense shrubby vegetation in mountain canyons and often among rocks in riparian areas. | No suitable habitat present. Study area is within critical landscape linkage and a potential habitat restoration area for this species. |
| Mexican garter snake<br>*Thamnophis eques megalops* | FSC, SDCP, BLM, WC, * | Intact riparian vegetation communities near permanent water. Cienegas within desert grasslands to elevations of 8,500 feet. | Historically known from study area. Currently not expected to occur due to limited riparian vegetation and lack of permanent water. |
| Tucson shovel-nosed snake<br>*Chionactis occipitalis klauberi* | SDCP | Mixed riparian scrub, Sonoran desert scrub, mesquite bosques; sandy lose soil. | Not known to occur in the study area. Low potential to occur due to disturbed nature of site. |
| Ground snake<br>*Sonora semiannulata* | SDCP | Grasslands, desert scrubplains, valleys and foothills; poorly drained soils. | Not expected to occur on the study area due to lack of suitable habitat. |
| Birds (Nomenclature from American Ornithologists' Union) | | | |
| Swainson's hawk<br>*Buteo swainsonii* | FSC, WC, SDCP, USFS | Nesting occurs in grasslands, semi-desert grasslands and savanna grassland. Wide range of habitat used for foraging. | No nesting habitat present. SDCP identifies the study area as having moderate habitat roosting and foraging potential for this species. |
| Western yellow-billed cuckoo<br>*Coccyzus americanus occidentalis* | FPE, SDCP, USFS, WC | Cottonwood-willow forests near running water. Mesquite bosques during monsoon season. | Historic record south of study area. SDCP identifies high quality habitat located in the river bend area and in some upland habitat. Currently, no mature riparian forests occur in the study area. Potential habitat remains east of the study area. |
| Cactus ferruginous pygmy-owl<br>*Glaucidium brasilianum cactorum* | FE, SDCP, WC | Wide variety of vegetation types. Generally desert scrub communities. | Historically known to occur in the vicinity. Study area is identified as having moderate to high habitat potential for this species. |
| Western burrowing owl<br>*Athene cunicularia hypugaea* | SDCP | Open grasslands, pastures, and desert scrub. | Study area has low potential habitat for this species due to urbanization and soil cement banks. |

**TABLE 4.3-4**
**SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA**
**(continued)**

| Species | Status | Habitat | Occurrence/Comments |
|---|---|---|---|
| Southwestern willow flycatcher<br>*Empidonax traillii extimus* | FE, SDCP, WC | Riparian areas and tamarisk in low elevations. | The eastern portion study area is identified by the SDCP as having moderate to high habitat potential for this species. Currently, the riparian vegetation is too patchy and sparse to support this species. |
| Bell's vireo<br>*Vireo bellii* | SDCP | Low shrubby vegetation in riparian areas, dense shrubland or woodland along lowland stream courses. | Not known from the study area; however, the eastern portion of the study area is identified by SDCP as having moderate to high habitat and is within a Priority Conservation Area 1. Currently, the lack of mature riparian vegetation and disturbed nature of the site likely precludes this species. |
| Rufous-winged sparrow<br>*Aimophila carpalis* | SDCP | Flat to gently hilly Sonoran desert scrub and Sinoloan thorn scrub. Grasses are an essential component of habitat. | Historically known from the vicinity. Urbanization along the Rillito River likely precludes this species from occurring in the study area. |
| Abert's towhee†<br>*Pipilo aberti* | SDCP | Sonoran riparian deciduous woodland and riparian scrub with dense shrub understory. | SDCP identifies the Rillito River as having medium to high potential habitat. Degraded riparian habitat offers only low potential habitat. |
| <u>Mammals</u> | | | |
| Western red bat<br>*Lasiurus blossevilli* | USFS, WC, SDCP | Broadleaf riparian deciduous forests and woodlands. | No present or historic occurrences recorded near the study area. Low potential to occur in the study area due to the limited availability of suitable roosting and foraging. |
| Western yellow bat<br>*Lasiurus xanthinu* | WC, SDCP | Fan palm trees and broadleaf riparian deciduous forests and woodlands. | Historical records occur from the vicinity of the study area. Due to the limited availability of trees and roosting habitat, there is a low potential for this species to occur. |

**TABLE 4.3-4**
**SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA**
**(continued)**

| Species | Status | Habitat | Occurrence/Comments |
|---|---|---|---|
| Lesser long-nosed bat<br>*Leptonycteris curasoae yerbabuena* | FE, SDCP, USFS, WC | Semi-desert grasslands and Sonoran desert scrub. | Low potential to occur due to lack of suitable nectaring, foraging, and roosting habitat. SDCP identifies low to moderate potential habitat. |
| California leaf-nosed bat<br>*Macrotus californicus* | FSC, SDCP, USFS, WC | Caves, mines, and rock shelters in Sonoran desert scrub. | SDCP identifies the eastern portion of the study area as moderate potential habitat and the majority of the site as low potential habitat. No roosting habitat is available on-site. Not expected to occur. |
| Pale Townsend's big-eared bat<br>*Plecotus townsendii pallescens* | FSC, WC, SDCP | Variety of habitats. | SDCP identifies low to moderate potential habitat in the study area. Historical records occur in the vicinity. Currently, there is a low potential for this species to forage on-site. |
| Arizona shrew<br>*Sorex arizonae* | FSC, WC, USFS, SDCP | Downed woody debris, surface water along drainages in mountain canyons above 5,675 feet. | Not expected to occur due to elevation limits and lack of suitable habitat. SDCP identifies low to moderate potential habitat in the study area. |
| Merriam's mouse<br>*Peromyscus merriami* | WC, SDCP | Heavy, forest-like strands of mesquite, thick cholla, prickly pear, paloverde and grasses. | Habitat degradation likely precludes this species from inhabiting study area. SDCP identifies small areas of moderate and high potential habitat for this species in the eastern portion of the project area. |

NOTE: See Table 5 for sensitivity codes.

**TABLE 4.3-5**
**SPECIES STATUS CODES**

**PIMA COUNTY**

PNP = Protected Native Plant Species

SDCP = Sonoran Desert Conservation Plan Priority Vulnerable Species

**STATE**

WC = Arizona Game and Fish Department: Wildlife of Special Concern. Species whose occurrence in Arizona is or may be in jeopardy, or known or perceived threats or population declines as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona.

SR = Arizona Department of Agriculture, Arizona Native Plant Law: Salvage Restricted. Collection by permit only.

HS = Arizona Department of Agriculture, Arizona Native Plant Law: Highly Safeguarded. No collection allowed.

**FEDERAL**

FE = Federally endangered, Endangered Species Act. Listed endangered, imminent jeopardy of extinction.

FT = Federally threatened, Endangered Species Act. Listed threatened, imminent jeopardy of becoming endangered.

FPE = Federally proposed endangered, Endangered Species Act.

FC = Federal Candidate for listing (taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list as endangered or threatened; development and publication of proposed rules for these taxa are anticipated).

FSC = Species of Concern. Taxa whose conservation status is of concern to the U.S. Fish and Wildlife Service, without official status.

USFS = US Forest Service Sensitive: Those taxa occurring on National Forests in Arizona which are considered sensitive by the Regional Forester.

BLM = US Bureau of Land Management Sensitive: those taxa occurring on BLM Field Office Lands in Arizona which are considered sensitive by the Arizona State Office.

long on the branches. Whitish, miniscule flowers bloom in summer and are followed by egg-shaped berries in the fall (Epple 1995). Desert hackberry is found in washes, canyons, and open desert between 1,500 and 3,500 feet and provides food and cover for a variety of wildlife species. Its range includes western Texas to Arizona and northern Mexico (Kearny 1960).

A few desert hackberry were found at the edge of the mesquite bosque located west of the Dodge Road crossing.

**Western desert willow (*Chilopsis linearis* var. *arcuata*).** Western desert willow is a Pima County Protected Native Plant. A large shrub or small tree in the Bignonia family (Bignoniaceae), desert willow has dark scaly brown bark and narrow light green un-serrated leaves. Large tubular white flowers with lavender and yellow tinge bloom from April through August. Desert willow grows along washes and other waterways in the desert, foothills, grasslands, and on mesas from 1,500 to 5,000 feet and ranges from western Texas to southern New Mexico, Arizona, and California to northern Mexico (Kearney and Peebles 1960).

Desert willow were scattered throughout the mesquite bosque and the streambed.

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**Arizona fishhook barrel cactus (*Ferocactus wislizenii*).** Arizona fishhook barrel cactus is a Pima County Protected Native Plant. A member of the cactus family (Cactaceae), Arizona fishhook barrel cactus can reach a maximum height of 11 feet and be up to two feet in diameter. It forms a single ribbed cylindrical trunk with clusters of spines along each rib. The spines are gray to reddish in color with slender hooked spines around a central two-inch-long spine. Orange, red, and yellow cup-shaped flowers bloom from June through September. Seeds are contained in a spiny barrel-shaped fruit up to two inches long that is present year round. It is commonly referred to as the "compass cactus" as faster growth on the shady side of the cactus causes it to lean in a southerly direction (Epple 1995). Arizona fishhook barrel cactus can be found in sandy or gravelly desert and grassland habitat from 1,000 to 4,500 feet and ranges from western Texas to southern New Mexico and Arizona to northern Mexico (Kearney and Peebles 1960).

A few Arizona fishhook barrel cactus were identified in the Paloverde-Cacti desert scrub habitat on-site.

**Velvet mesquite (*Prosopsis velutina*).** Velvet mesquite is a Pima County Protected Native Plant. A deciduous large shrub or small tree in the Pea family (Fabaceae), velvet mesquite has dark brown bark that separates into narrow strips along the trunk, with greenish yellow leaves along four-inch cylindrical spikes. Narrow seed pods up to eight inches long grow at the end of the spikes. Velvet mesquite, which blooms in April and sometimes again in August following monsoon rains, can be found in desert washes, along streams and in areas with high groundwater below 5,000 feet. Its range extends

from southern Kansas to southeastern California and northern Mexico (Munz 1974). Mesquite is an excellent source of honey for bees and its seed pods provide a source of food for wildlife, making up 80 percent of a coyote's fall diet (Epple 1995).

Velvet mesquite is the dominant species of the mesquite bosques on-site and is present in the Paloverde-Cacti habitat. A few smaller velvet mesquite occur in the streambed within the Sonoran riparian scrubland habitat.

### b. Species with Potential to Occur

**Sensitive Wildlife.** Currently, no sensitive wildlife species are known to occur in the El Rio Antiguo study area. A few historic occurrences (from 1893 to 1981) of Mexican garter snake (*Thamnophis eques megalops*), cactus ferruginous pygmy owl (*Glaucidium brasilianum cactorum*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and occult little brown bat (*Myotis lucifugus occultus*) are documented within one mile of the study area; however, the majority of habitat for these species has been developed. The historic occurrence records for these species are shown in Figure 4.3-4.

During the development of the SDCP, modeled potential habitat and priority conservation areas were designated for all priority vulnerable species within the Plan's jurisdiction. Eighteen species were identified to have potential to occur in the El Rio Antiguo study area. These species are addressed in Table 4.3-4 and discussed further in Appendix A of this section.

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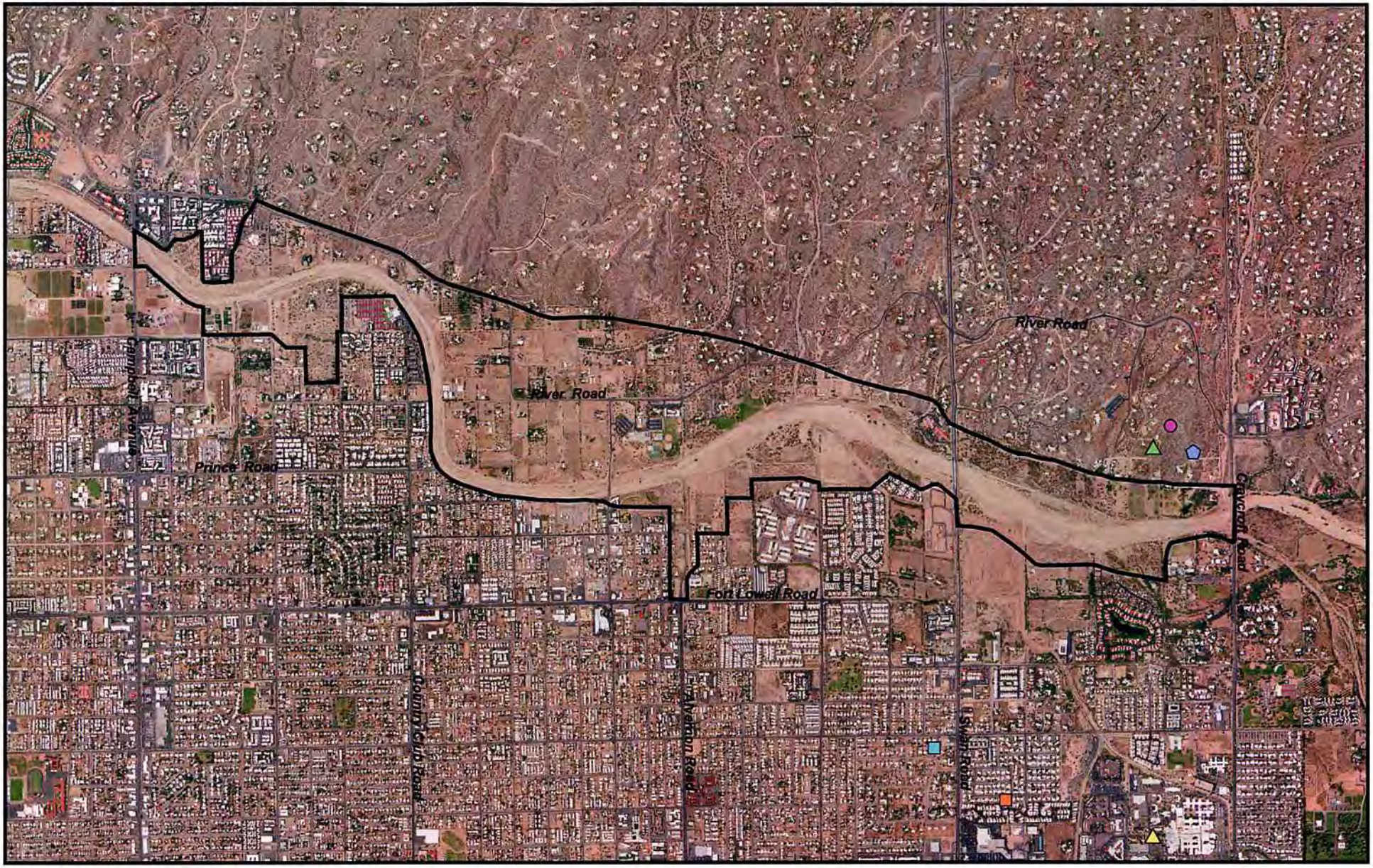
# 4.3.3 Regulatory Setting

## 4.3.3.1 Federal

**Clean Water Act** (CWA) (Public Law 92-500, as amended; 33 U.S.C. 1251 et seq.). "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" [Section 10(a)]. Section 404 of the act deals with discharge of dredge or fill material into waters of the U.S. Regulatory authority has been delegated by the Environmental Protection Agency (EPA) to the U.S. Army Corps of Engineers for Section 404.

**Endangered Species Act of 1973** (Public Law 93-205; 16 U.S.C. 1531 et seq.). Provides for listing of endangered and threatened species of plants and animals and designation of critical habitat for animal species. Establishes federal policy that federal agencies, in exercise of their authorities, shall seek to conserve endangered species. Prohibits federal agencies from taking any action that would adversely affect any endangered or threatened species or critical habitat. Establishes a consultation process involving federal agencies generally and federal wildlife management agencies to facilitate avoidance of agency




RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

Study area

0 Mile 0.5

Sensitive Species (date last observed) (Source: HDMS 2001)

- Cactus ferruginous pygmy-owl (1916)
- Western yellow-billed cuckoo (1893)
- Mexican garter snake (1960)
- Black-tailed prairie dog (pre-1970)
- Occult little brown bat (1992)
- Duck potato (1905)

# FIGURE 4.3-4

## Historical Occurrences of Sensitive Species Adjacent to the Study Area

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action that would adversely affect species or habitat. Prohibits all persons subject to U.S. jurisdiction from "taking" endangered species. "Taking" prohibition includes any harm or harassment and applies within the U.S. and on the high seas.

**Federal Noxious Weed Act of 1974** (Public Law 93-629; 7 U.S.C. 2801). Provides for the control and eradication of noxious weeds and their regulation in interstate and foreign commerce.

**Fish and Wildlife Coordination Act** (Public Law 85-624; 16 U.S.C. 661 et seq.). Assures that wildlife conservation shall receive equal consideration and be coordinated with other features of water resource development. Federal agencies (or other agencies with federal permit) proposing to impound, divert, or control waters are required to consult with the U.S. Fish and Wildlife Service and the state wildlife agency. The act authorized project modification, acquisition of land, and other measures necessary to protect wildlife.

**Migratory Bird Treaty Act of 1918** (Public Law 65-186; 16 U.S.C. 703 et seq.). The Act prohibits the "taking" of migratory birds, their nests, eggs, parts, or products without the appropriate permit and provides enforcement authority and penalties for violations. The act protects all but a very few species of birds inhabiting the United States.

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**National Environmental Policy Act of 1969** (NEPA) (Public Law 91-190; 42 U.S.C. 4321 et seq.). Mandates federal agencies to consider and document environmental impacts of proposed actions and legislation. Also mandates preparation of comprehensive environmental impact statements where proposed action is "major" and significantly affects the quality of the human environment.

**Rivers and Harbors Act of 1889** (33 U.S.C. 401 et seq.). Requires authorization from the U.S. Army Corps of Engineers for the construction of any structure or obstruction, excavation/dredging, or deposition of material in or over any navigable water of the United States.

**Executive Order 11988**: **Floodplain Management.** Specifies that "Agencies shall also encourage and provide appropriate guidance to applicants to evaluate the effects of their proposals in floodplains prior to submitting applications." This order includes wetlands that are within the 100-year floodplain and especially discourages filling.

**Executive Order 13112: Invasive Species.** Directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

**Executive Order 11990: Protection of Wetlands.** Directs all federal agencies to "take action to minimize the destruction, loss or degradation of wetlands, and to preserve and

enhance the natural and beneficial values of wetlands." This applies to the acquisition, management, and disposal of federal lands and facilities; to construction or improvements undertaken, financed, or assisted by the federal government; and to the conduct of federal activities and programs which affect land use. Section 4 of the Executive Order requires that when federally owned lands are leased and easement is assigned, or when disposed of to a nonfederal party, a reference be included in the conveyance to identify any wetlands and to indicate those uses which are restricted in such areas.

### 4.3.3.2 State

**Arizona Native Plant Law.** "Most of the desert plants fall into one of five groups specially protected from theft, vandalism or unnecessary destruction by Arizona's Native Plant Law. Landowners have the right to destroy or remove plants growing on their land, but 20 to 60 days prior to the destruction of any protected native plants, landowners are required to notify the Arizona Department of Agriculture. The landowner also has the right to sell or give away any plant growing on the land. However, protected native plants growing may not be legally possessed, taken or transported from the growing site without a permit from the Arizona Department of Agriculture." (University of Arizona 2001).

**Arizona Game and Fish Department** (A.R.S. 17-201 et seq.). Title 12 of the Game and Fish Code addresses a variety of laws a regulations applicable to Natural Resources.

### 4.3.3.3 Local

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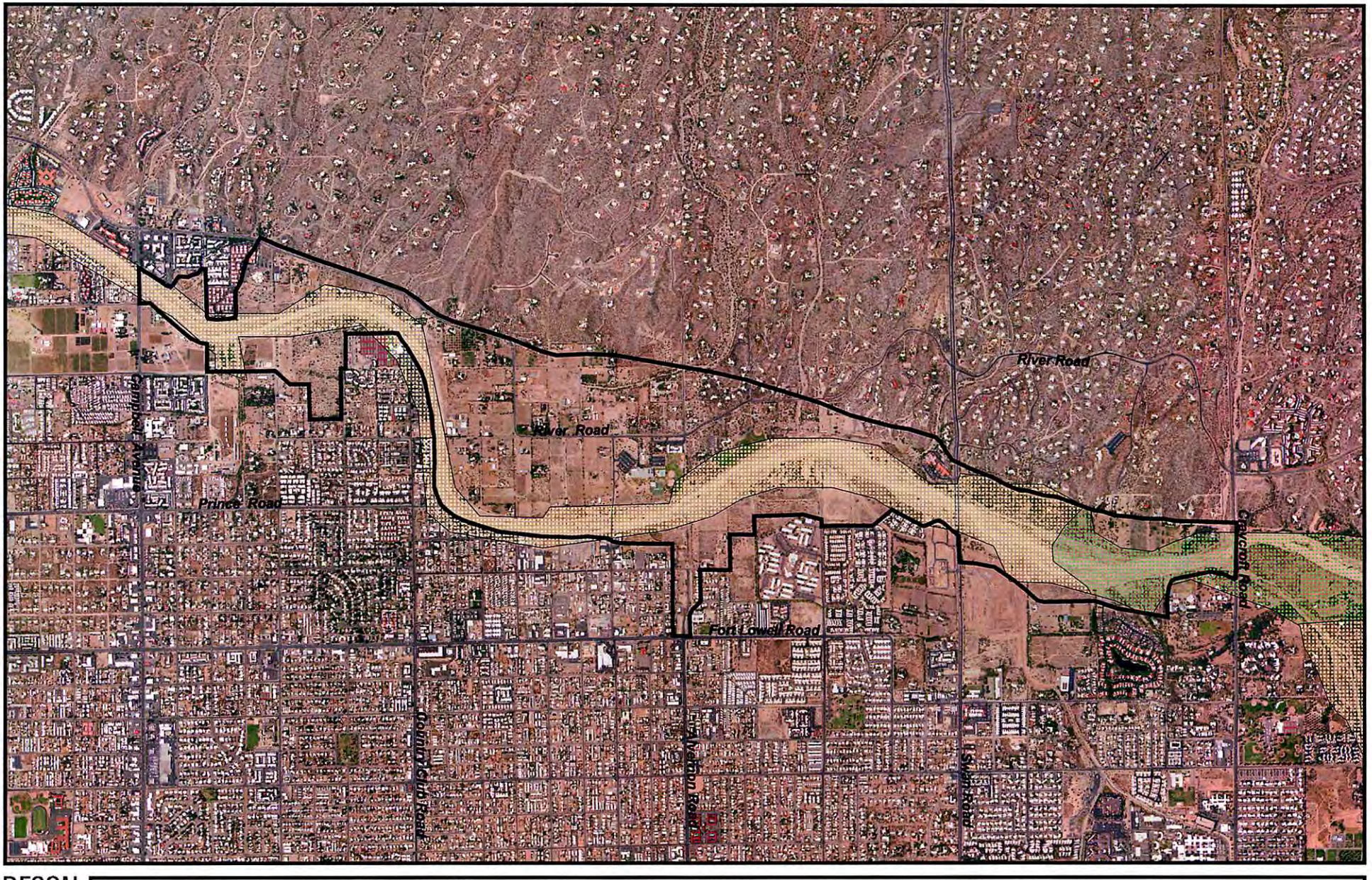
El Rio Antiguo falls within the Conservation Lands System (CLS) that is part of an updated comprehensive resource management plan for Pima County. Within the CLS, the majority of the site is identified as a Multiple Use Management Area. This is shown in Figure 4.3-5. Multiple Use Management Areas are those areas defined by the SDCP by the occurrence of high potential habitat for three or more priority vulnerable species and special elements. According to the SDCP, land use and management goals within multiple use areas will focus on balancing conservation, restoration, and enhancement of natural communities with other uses compatible with the maintenance of biological values.

The east side of the project site, east of the midway point between Swan Road and Craycroft Road, is a designated Biological Core Management Area. Biological Core Management Areas are defined by the occurrence of high potential habitat for five or more priority vulnerable species, special elements (e.g., caves, perennial streams, cottonwood-willow forests), and other unique biological features (Pima County 2001a). El Rio Antiguo is identified as potential habitat for 18 Sonoran Desert Conservation Plan Priority Vulnerable Species, including five bats, two small mammals, five birds, one amphibian, three reptiles, and one plant species. Land use and the goal of management within biological core management areas will focus on conservation, restoration, and enhancement of natural communities, with provisions for other non-consumptive uses consistent with maintenance of biological value (Pima County 2001b).




RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

0 Mile 0.5

Study area

Conservation Lands System
(Source: RECON 2002)

Biological Core

Mulitple Use

# FIGURE 4.3-5

## Conservation Lands System in the Study Area

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# 4.4 Land Use

## 4.4.1 Introduction

This section presents a characterization of existing land uses in the vicinity of the El Rio Antiguo study area. A brief history of land use planning, and land use in the study area is discussed. The regulatory setting includes a discussion of the local government organizations with planning jurisdiction in the area, and information on the guidance for future development.

## 4.4.2 Environmental Setting

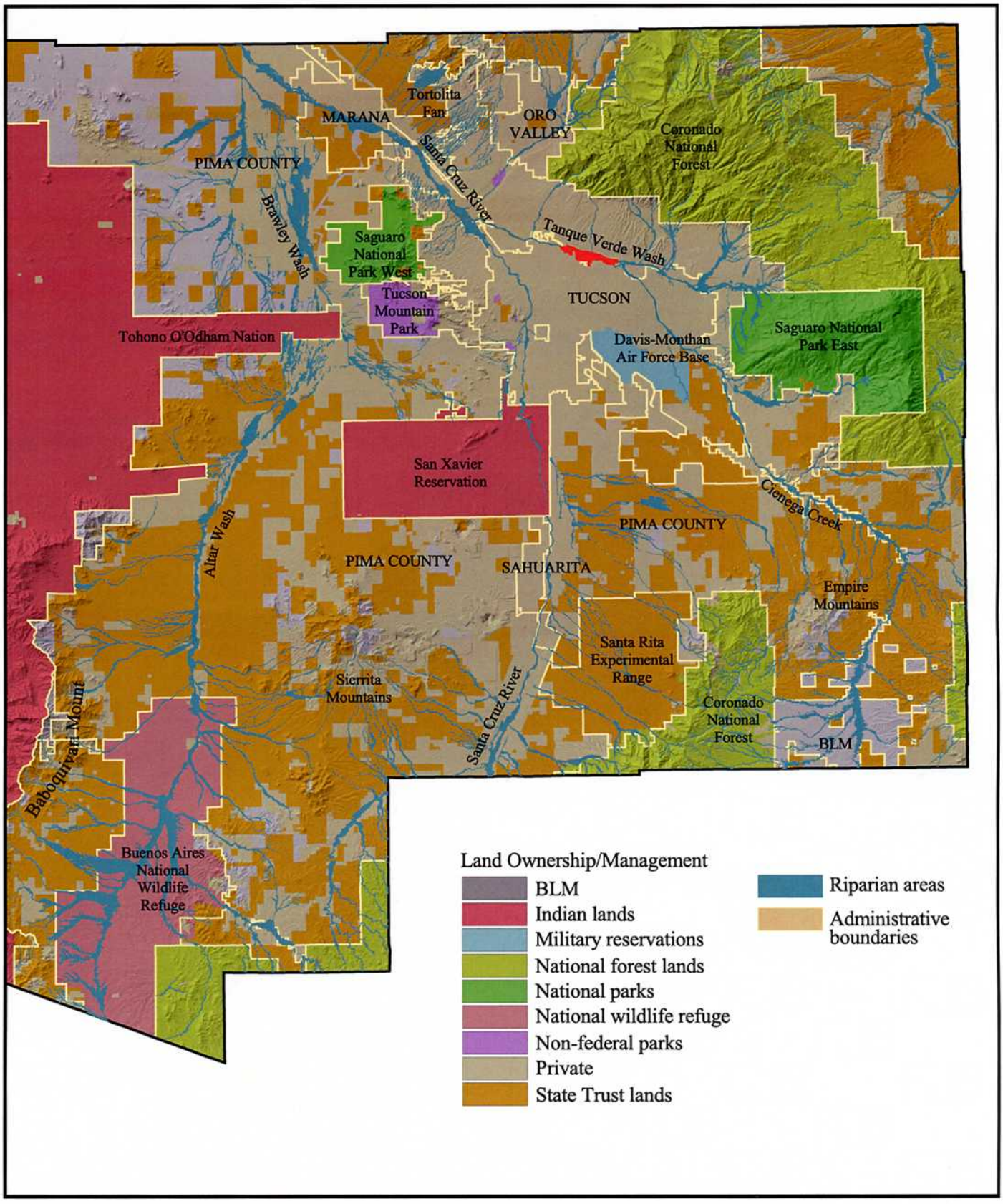
The El Rio Antiguo study area is located in the north-central portion of the city of Tucson in eastern Pima County, Arizona. The most prominent feature of the El Rio Antiguo study area is the Rillito River. The river can be generally characterized as a broad dry wash during most of the year. Occasionally the river runs substantially and may even flood during summer thunderstorms. Adding to the wash aspect of the Rillito River are the washes to the north and south that drain into the River. To the north of the Rillito River are the washes and alluvial fans that are a result of drainage and sediment deposition from the tributaries originating in the Santa Catalina Mountains. The study area lies between these mountains and the urbanized city of Tucson.

Draft

### 4.4.2.1 History of Land Use Planning

Settlement and growth patterns in the Tucson area have been shaped by natural as well as anthropogenic influences. Natural influences include topography and watercourses. Transportation routes, while anthropogenic in nature, are influenced by natural features as well. Figure 4.4-1 shows features that have influenced the settlement and growth patterns in eastern Pima County. The four most prominent land use shaping features are topography, watercourses, transportation routes, and governmental lands. These features have affected and influenced natural, constructed, and administrative issues. Transportation routes evolved as overland routes, railroads, and highways. Administrative influences that have guided land use decisions include territorial and Arizona State Trust lands, Tohono O'odham Nation, Coronado National Forest, Santa Rita Experimental Range, Tucson Airport and Davis-Monthan Air Force Base, Saguaro National Park, and other public landed owned by county, state, and federal entities.

Throughout the decades, many land use planning initiatives and decisions have attempted to guide land use planning efforts. In the 1930s, the City of Tucson adopted its first zoning ordinance. In the 1940s, planning issues were the focus of most community discussions. During the 1950s, the focus shifted to master planning, particularly the




RECON

Pima County

Study area

0 Miles 10

# FIGURE 4.4-1

**Land Use Shaping Features in Eastern Pima County**

### 4.4.2.3 Existing Land Use

The study area currently contains a variety of land uses. It consists of mainly residential areas, rural type areas with agricultural uses, privately owned ranches, light industrial and commercial uses, as well as open space and public parks. Figure 4.4-2 shows the land use in and around the El Rio Antiguo study area. Table 4.4-1 lists the corresponding acres of land use category in the study area.

Within the Rillito River, Pima County Department of Transportation and Flood Control District own most of the land which functions as a dry riverbed with occasional water flow after periods of rain. Most land outside of the River is primarily privately owned.

To the north of the Rillito River, several properties support small privately owned livestock and ranch operations within the study area. In the area along the south of the Rillito River, an agriculture research facility is operated by the University of Arizona. Light industrial and commercial land uses to the south of the Rillito River in the study area include closed landfills, formerly operated as sand and gravel operations. The Tucson Electric Power North East substation is located adjacent to the Rillito River, by Dodge Boulevard. The area south of the Rillito River includes light industrial and commercial land uses. Development of shopping plazas and apartments has occurred south of the Rillito, near Swan Road.

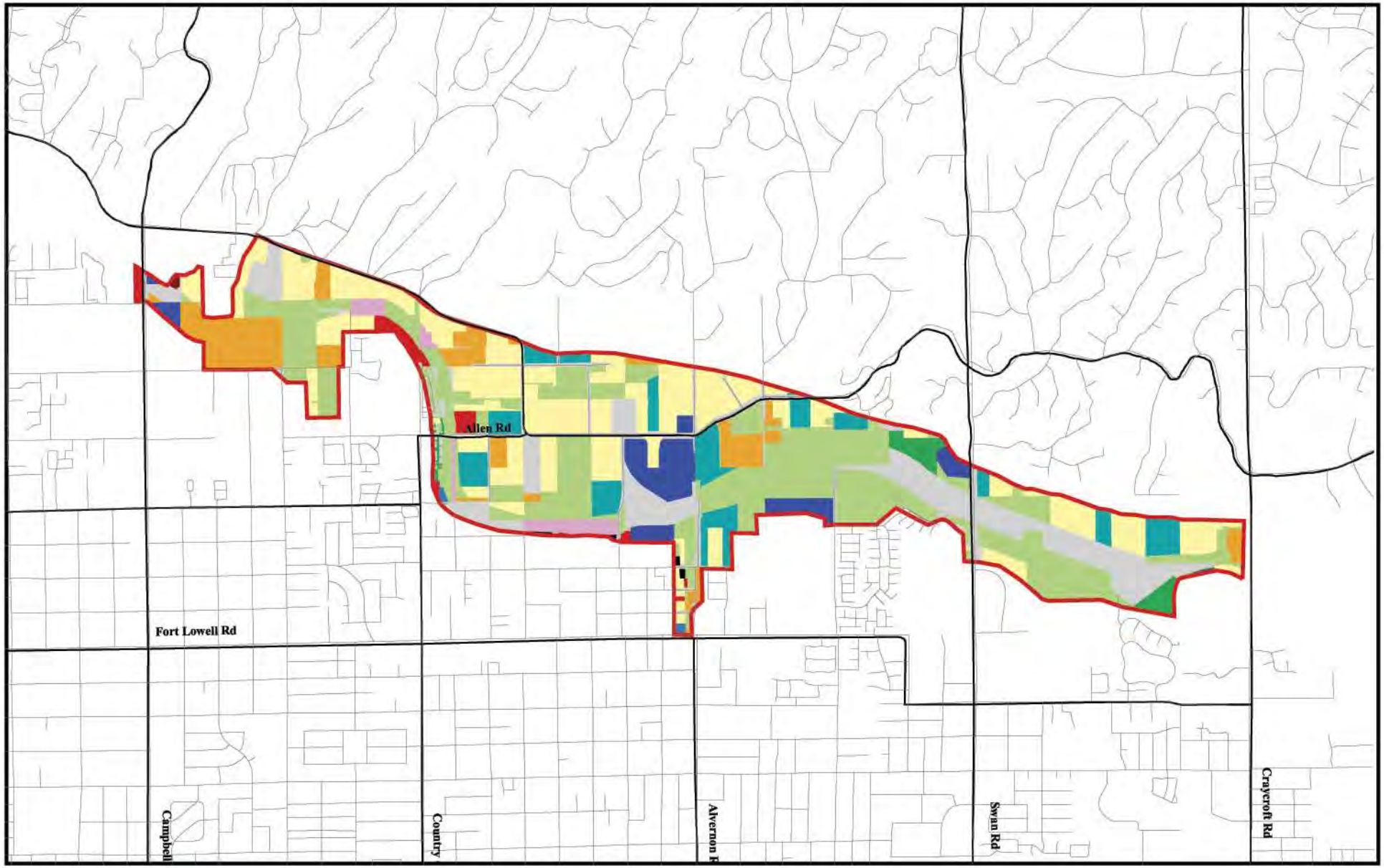
Draft

A prominent land use feature in the Rillito River, as well as the surrounding area, is public and private recreation land uses. These areas are discussed in more detail in Section 4.6, Recreation. The Rillito River functions as a river park with trails. Several parks within close vicinity to the Rillito River and the El Rio Antiguo study area have typical park amenities and recreational opportunities.

The areas adjoining the El Rio Antiguo study area have surrounding land use that is predominantly residential, interspersed with commercial properties with some manufacturing or light industrial use. There are no heavy industrial areas near the study area.

## 4.4.3 Regulatory Setting

The northern portion of the El Rio Antiguo study area lies within unincorporated Pima County and is, therefore, governed by county planning and development activities. The southern portion of the study area lies within the Tucson City limits and is governed by City of Tucson planning and development rules and regulations. There are numerous regulations, goals, and objectives contained in the various planning documents produced by the two jurisdictions. Each jurisdiction is responsible for maintaining a quality environment for its citizens through long-range planning. The regulatory environment is presented below for the respective government agencies.




RECON

Study area

0 Mile .5

Land Use Categories

- Industrial
- Commercial
- Lodging
- Agricultural
- Residential
- Government
- Utility
- Office
- Institutional
- Open Space
- Rural
- Vacant
- Other

# FIGURE 4.4-2

**Land Use Designations In the Study Area**

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rezoning of the Catalina Foothills. The 1960s saw the regional planning initiative, and the 1970s welcomed the Eastern Pima County Comprehensive Plan advocating a contained development pattern. Over the decades, the essence of urban land use planning has centered on planning issues such as transit, schools, streets, building codes, subdivision regulations, railroads, blighted areas, playgrounds, population, and the economic base of Tucson.

While early land use planning initiatives demonstrated an awareness of the natural and economic resource issues at stake, few plans actually were implemented, and few implemented plans have been effective tools for guiding population growth in a manner that protects the resource base. At times, growth has been faster than the ideas could be developed and implemented. While at other times, past recommendations that might have led to greater protection of fiscal and natural resources were not fully grasped or implemented. More recently, Pima County updated its Comprehensive Plan in December of 2001. The City of Tucson's Comprehensive Plan is dated 2001.

### 4.4.2.2 Historic Land Use

Historically, the El Rio Antiguo portion of the Rillito River was a perennially watered riparian area of southeastern Arizona, with highly productive cottonwoods, willows, and mesquite habitats. As areas in and around the watershed became developed, much of the biological resources and habitat in the study area degraded significantly, displacing much of the riparian and upland vegetation that once occupied the area.

draft

Land use development in the study area began mostly as agricultural and ranching activities, with a few scattered residences nestled among native desert vegetation. Prior to 1940, the primary land uses were agriculture and residential. During the 1950s and 1960s, development began in the study area in several areas as the city of Tucson began expanding to the north. Properties north of the Rillito River supported small privately owned ranch and livestock operations, as well as residences.

As properties to the north of the Rillito River saw an increase in residential development, properties to the south of the Rillito River saw an increase in residential development, as well as some industrial and commercial operations including landfills and sand and gravel operations. To the south of the Rillito River, what began as sand and gravel operations eventually became landfill operations during the 1960s to the 1980s. In the southeast corner of the study area, agriculture and research facilities were developed for the University of Arizona.

Continuing through the 1970s and 1980s, the area south of the Rillito River developed as a mixed-industrial and commercial area in the general vicinity of Kleindale Avenue. More recently, the area around Swan Road has developed as a corporate center with shopping plazas and apartments.

**TABLE 4.4-1**
**LAND USE DESIGNATIONS IN THE**
**EL RIO ANTIGUO STUDY AREA**

| Land Use | Acres |
|---|---|
| Residential | 288.93 |
| Agricultural | 7.12 |
| Commercial | 14.48 |
| Industrial | 1.61 |
| Institutional | 57.53 |
| Lodging | 0.93 |
| Governmental | 88.48 |
| Office | 1.76 |
| Rural | 85.74 |
| Utilities | 20.57 |
| Vacant | 338.92 |
| Dedicated Open Space | 20.63 |
| Other | 199.01 |
| TOTAL | 1126.10 |

## 4.4.3.1 Pima County Comprehensive Plan

In 1992, as required by state law, Pima County prepared a comprehensive plan that was subsequently updated in December 2001. The purpose of the comprehensive plan is defined in state law this way: "The comprehensive plan shall be developed so as to conserve the natural resources of the county, to ensure efficient expenditure of public funds, and to promote health, safety, convenience, and general welfare of the public. Such comprehensive plan may include but not be limited to, among other things, studies and recommendations relative to the location, character and extent of highways, railroads, bus and other transportation routes, bicycle facilities, bridges, public buildings, public services, schools, parks, open space, housing quality, variety and affordability, parkways, hiking and riding trails, airports, forests, wildlife areas, dams, projects affecting conservation of natural resources, air quality, water quality and floodplain zoning. Such comprehensive plan shall be a public record, but its purpose and effect shall be primarily as an aid to the county planning and zoning commission in the performance of its duties" (Pima County 2001).

The 2001 updated Pima County Comprehensive Plan (PCCP) combine short-term actions to protect and enhance the natural environment and long-range planning to ensure that our natural and urban environments not only coexist but develop an interdependent relationship, where one enhances the other (Pima County 2001). The Conservation Lands System of the PCCP is intended to reflect land use concepts, policies, and principles of conservation identified in the draft Preliminary Sonoran Desert Conservation Plan (SDCP).

Draft

### a. Land Use Element

The PCCP includes a land use plan that provides a long-range guide to growth and development in unincorporated eastern Pima County. According to the PCCP, the Land Use Element of the Comprehensive Plan is defined by state law to include the "proposed general distribution and location and extent of uses of the land for housing, business, industry, agriculture, recreation, education, public buildings and grounds, open space and other categories of public and private uses of land appropriate to the county" (Pima County 2001).

## 4.4.3.2 Sonoran Desert Conservation Plan

In 1998, the Pima County Board of Supervisors launched the Sonoran Desert Conservation Plan with the goal of combining short-term actions to protect and enhance the natural environment and long-range planning to ensure that our natural and urban environments not only coexist but develop an interdependent relationship, where one enhances the other. In 2000, the Board accepted the Preliminary Sonoran Desert Conservation Plan, which sketched the outline of its six elements: (1) Ranch Conservation Element; (2) Cultural Resources Element; (3) Mountain Parks Element; (4) Riparian Protection,

Management, and Restoration Element; and (5-6) Habitat and Corridors Protection Elements. Pima County is nearing completion of the Sonoran Desert Conservation Plan and will apply for a permit under the Endangered Species Act in 2002 (Pima County 2001).

### 4.4.3.3 City of Tucson General Plan

The City of Tucson General Plan regulates planning and development activities within incorporated areas of the city in the vicinity of the El Rio Antiguo study area. The Land Use Element identifies policies that, along with other elements of the General Plan, describe the City's vision for physical development by providing criteria for the location and intensity of future land uses (City of Tucson, November 2001).

The City of Tucson General Plan establishes "Livable Tucson Goals." These include:

- Infill and reinvestment, not urban sprawl which includes well-planned growth, the management of urban sprawl, and development within the city rather than just on its periphery.

- Abundant urban green space and recreation areas which include recreation and green space within the city such as neighbor and regional parks, common space, community gardens, bike and walking paths, linear and river parks, and trees and urban landscaping.

- Protection of the natural desert environment which includes protection of the Sonoran Desert ecosystem and protection of washes, hillsides, open space, and wildlife.

draft

## 4.4.4 References

Pima County

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Pima County Comprehensive Plan website
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Sonoran Desert Conservation Plan website
http://www.dsd.co.pima.az.us/CPupdate/comp.htm

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# 4.5 Aesthetic Resources

## 4.5.1 Introduction

This section describes the existing aesthetic resources and conditions in the study area. A series of photographs is included to illustrate the conditions in the study area, particularly along the river corridor. In addition, a descriptive aesthetic overview of the Tucson area, as well as the vicinity of the area is provided. Regulations, plans, goals, and policies related to aesthetic resources that may be pertinent to the study are also discussed. Other descriptive details on the physical conditions that influence the visual and aesthetic character of the study area can be found in Sections 4.1, "Topography and Geography"; 4.2, "Hydrology and Water Resources"; 4.3, "Biological Resources"; and 4.4, "Land Use."

## 4.5.2 Environmental Setting

draft

The physical landscape, climatic characteristics, and diversity of biotic communities all contribute to the visually rich environment in the Tucson area, and the resultant landscapes provide a unique opportunity for aesthetic resources. The remarkable scenery in the Tucson area is striking not only to visitors, but to long-time residents as well. Tucson is famous for its picturesque views of mountains, desert landscape, and mild climate. The study area is situated in the midst of this located along the Rillito River in the Tucson Valley. The Tucson Valley is surrounded on the north by the Santa Catalina Mountains (9,100 feet or 2,770 meters), on the east by the Rincon Mountains (8,480 feet or 2,580 meters), on the west by the Tucson Mountains (4,00 feet or 1,220 meters), and on the south by the expansive Tucson Valley, eventually reaching the Sierrita Mountains (5,990 feet or 1,820 meters) in the southwest, and the Santa Rita Mountains (9,400 feet or 2,860 meters) in the southeast. The Santa Catalina and Rincon Mountain ranges tend to be relatively long, rugged, low, and trend northwest/southeast, while the Santa Rita and Tucson Mountains trend north/south. However, when standing in the Tucson Basin, one gets the impression that the Santa Catalina Mountains trend east/west, somewhat bordering the basin along the north, since the most prominent peaks generally trend east/west. When considered in their entirety, with the smaller, less prominent peaks, the range actually trends to the north/west, in much the same manner as the Rincon Mountains. Likewise, the Rincon Mountains appear to trend north/south, bordering the eastern edge of the basin; however, the mountains actually trend north/west, similar to the Santa Catalinas. The same applies to the Santa Rita Mountains. When viewed from the Tucson Basin, they give the impression of trending east/west, when they actually trend north/south when considered in their entirety with surrounding smaller peaks.

The view of the surrounding mountain ranges from the study area along Rillito River encompasses broad, sweeping vistas towards distant and irregular horizons. To the north lies the Santa Catalina Mountains, the highest of the mountain ranges, with steep, jagged crests towering over the gently rolling foothills. The Santa Catalina Mountains are light-colored in appearance, as are the Rincon Mountains to the east. In contrast, to the west are the Tucson Mountains that have a much darker surface color and a more rounded appearance. The contrast in soil colors between the darker volcanic Tucson Mountains and the lighter colors of the Santa Catalina and Rincon Mountains creates visual interest in the landscape, regardless of time of day or seasonal variations in vegetative cover.

While the Tucson landscape is dominated by isolated, rugged, and often steep-walled mountains, their presence is underscored by the relatively level to gently rolling terrain of the inter-mountain valleys. The most prominent defining feature of the Tucson Valley are the watercourses that dissect the valley floor. The Tucson Valley basin between the mountain ranges is broad and gently sloping, with watercourses and ridges creating somewhat rugged, but rolling terrain in the foothills region. The most prominent watercourse is the Santa Cruz River, which flows from the south between the Sierrita and Santa Rita Mountains, through the western portion of the Tucson Valley by the Tucson Mountains, continuing north through the Town of Marana. In general, most watercourses flow from the mountains into tributaries, flowing in the northwest direction, eventually joining with the Santa Cruz River. The Rillito is formed at the confluence of Pantano Wash and Tanque Verde Creek, which flows from the Rincon Mountains. Pantano Wash is formed at the confluence of Rincon Creek and Cienega Creek in the southeastern Tucson area. There are many washes that flow into the Rillito along the study site. Washes descending from the Santa Catalina Mountains through the foothills remain in a natural state, whereas the washes flowing into the Rillito from the south through the Tucson metropolitan area have been channelized and cemented.

Draft

### 4.5.2.1 Views from the Foothills

In the northern vicinity of the study area are the Santa Catalina foothills. The foothills region is characterized by Sonoran desert scrub vegetation, which includes the signature columnar cactus, the Saguaro, as well as mesquite and ironwood trees, and other cacti, shrubs, and smaller plants. Figure 4.5-1 shows the photograph locations, and Photograph 4.5-1 is representative of the typical setting in the foothills area. Development in the foothills region is one of a unique residential setting. Residential homes are nestled into the surrounding native vegetation leaving only the footprint of driveways and roads. The rolling hills topography of the foothills enables the houses to be situated in the landscape in a manor that provides a somewhat private setting. This unique environment is further enhanced by the natural washes and arroyos winding through the terrain as they descend from the Santa Catalina Mountains through the foothills. From the foothills, a direct view of the Rillito River is obscured by intervening terrain and vegetation, as shown in Photograph 4.5-2. However, south of the Rillito the

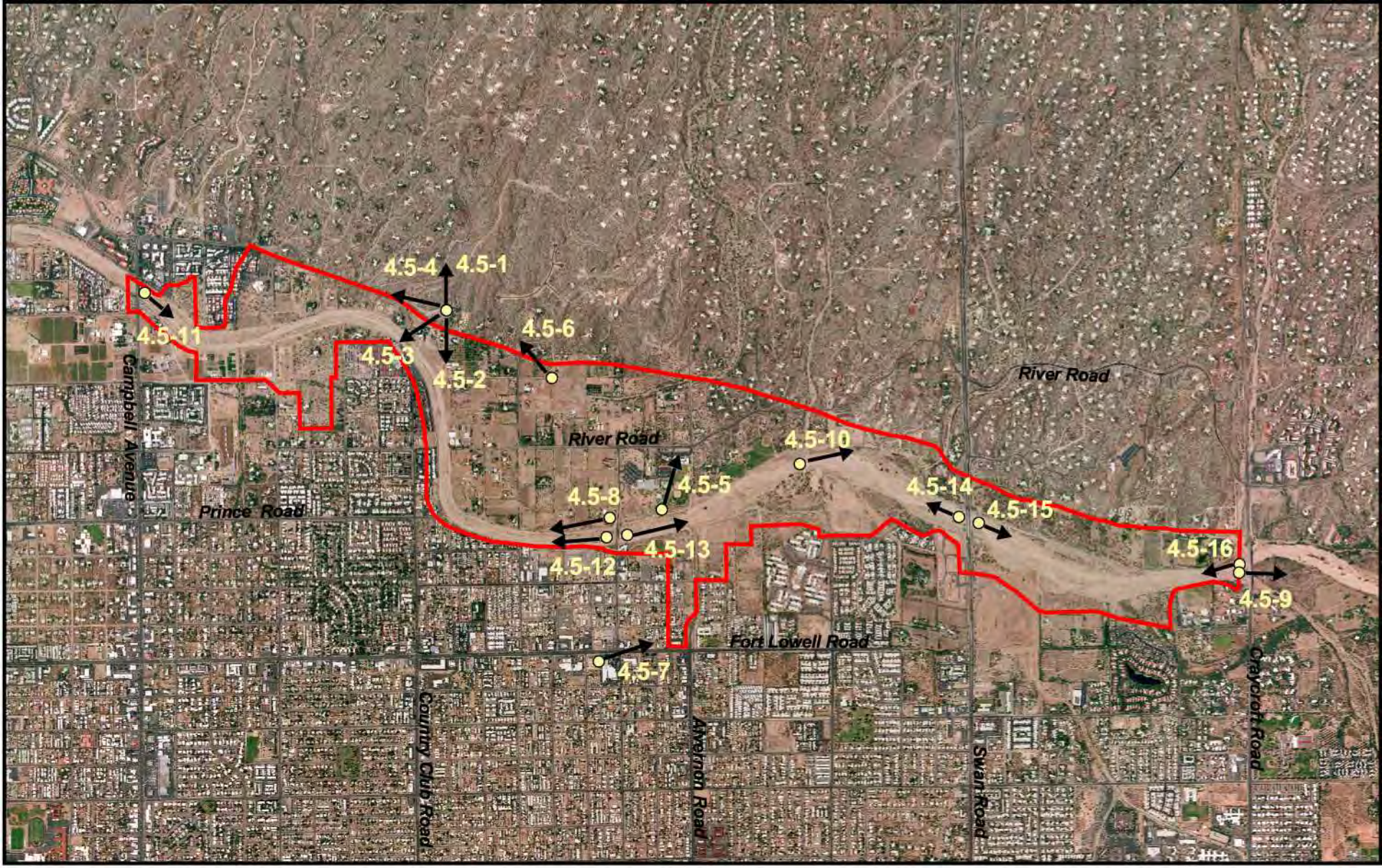


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Image Source: 2001 AirPhotoUSA (flown October 1999)

Study area

Photograph location and direction

0 Mile .5

# FIGURE 4.5-1

**Photograph Locations**

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PHOTOGRAPH 4.5-1

**View of the Santa Catalina Mountain foothills, Santa Catalina Mountains are in the background**

PHOTOGRAPH 4.5-2

**Typical view of the Rillito River area from the foothills, a direct view of the river is obscured by vegetation**

RECON

view of a relatively level basin floor with urban development. The higher density development south of the Rillito includes residential houses, apartments, and shopping centers, dotted with green pine and eucalyptus trees, and few native mesquite and paloverde trees. Photograph 4.5-3 shows a glimpse of apartments along the south bank of the Rillito River that are usually obscured by vegetation when viewed from the foothills. Views to the east are more open, and include the Rincon Mountains to the east, and the Santa Rita Mountains to the south. Views to the southwest sweeps over the red brick buildings of the University of Arizona campus, and high rises of the downtown Tucson metropolitan area, against the backdrop of "A" Mountain and the Tucson Mountains.

### 4.5.2.2 Views along River Road

River Road is the approximate northern boundary of the study site. When traveling west from Craycroft Road, the eastern boundary of the study site, the road meanders through the foothills area, as shown in Photograph 4.5-4, with its scattered houses and native desert vegetation, crosses several natural washes, then descends through a mesquite bosque area where a park and ballfield is situated among the mesquite trees. Photograph 4.5-5 shows a view of a ballfield with the picturesque Santa Catalina Mountains in the background. River Road then passes Dodge Boulevard, and winds through the Riverbed area that has a distinct rural character. Residences in this area are scattered, and often have cleared ground, with a few remaining mesquite trees, fences, and a horse or two, such as the one in Photograph 4.5-6. River Road then travels out of the riverbend area, past a more developed area, including apartments, an office complex and hotel, to Campbell Road, which is the western boundary of the study area.

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### 4.5.2.3 Views along Southern Boundary of Study Site

In contrast to the low-density residential foothills area, and rural riverbend area north of the Rillito River, the area south of the Rillito River has more urban characteristics. The basin floor south of the Rillito has been developed with a grid network of streets, typical of a bustling metropolitan area as shown in Photograph 4.5-7. Fort Lowell Road is the main road south of the Rillito that offers a direct route from Craycroft Road, the eastern study boundary, to Campbell Road, the western study boundary. The area between Fort Lowell Road and the Rillito River is a grid network of side streets with houses and businesses. Due to the generally flat topography of the basin, and development, views of the river from Fort Lowell Road, and most smaller side streets adjacent to the river, are obstructed by buildings. When traveling west on Fort Lowell Road, from Craycroft Road, there are small residential developments, apartments, and the Swan Corporate Center with offices and shops. Fort Lowell Road traverses over several washes that have been channelized and cemented, to run parallel with the streets leading to the Rillito River. Fort Lowell Road continues west, passing Dodge Boulevard, where the smaller side streets continue directly to the river, and facilities include Tucson Power electric transformer station, smaller housing complexes dotted with Eucalyptus trees, and the

PHOTOGRAPH 4.5-3

**View of the Rillito River from the foothills, the river along with the apartments are visible**

PHOTOGRAPH 4.5-4

**View along River Road in the foothills area**

RECON

PHOTOGRAPH 4.5-5

**View of ballfield park with lights, Santa Catalina Mountains in the background**

PHOTOGRAPH 4.5-6

**View of the riverbend area along River Road, this area has a distinct rural characteristic**

RECON

PHOTOGRAPH 4.5-7

**View of the typical urban street network south of the Rillito River**

PHOTOGRAPH 4.5-8

**View of the Tucson Electric Power Substation south of the Rillito River from Dodge Boulevard bridge**

RECON

Tucson Racquet Club with tennis courts and apartments. Photograph 4.5-8 shows a view of the electric transformer station from Dodge Boulevard bridge. Fort Lowell Road continues to Campbell, the eastern study site boundary, where the University of Arizona has its Agricultural and Pima County Cooperative extension, adjacent to the Rillito, giving the area a slightly rural characteristic in contrast to the adjacent metropolitan area.

### 4.5.2.4 Views West and East of the Study Area

West of the study site, the Rillito River continues past the Rillito Park and Tucson Mall, for approximately eight miles through a developed residential and commercial area, eventually joining with the Santa Cruz River. To the east of the study area, past the confluence that forms the Rillito, Tanque Verde Creek flows from the Rincon Mountains through the foothills area, and Pantano Wash flows from the southeastern area of Tucson through a more developed residential area. The confluence of Tanque Verde Creek and Pantano Wash is shown in Photograph 4.5-9. Some portions of Tanque Verde Creek and Pantano Wash to the east of Craycroft Road are natural, however, portions of these watercourses are soil cemented further upstream. The most striking contrast between Tanque Verde Creek and Pantano Wash is the riverbed. The riverbed along Tanque Verde Creek is light colored in appearance, and has fine sandy loams. In contrast, the riverbed of the Pantano Wash is darker in appearance, with larger river rocks. In general, the watercourses to the east of the study site are in a more natural state, with more vegetation and larger trees along the banks in the area adjacent to the study site.

Draft

### 4.5.2.5 Views from the Study Site and General Description of the River Corridor

The general topography of the study area is flat, which limits long-range viewing opportunities when looking from the river channel. Views of the Rillito River from the road crossings are characterized by a channel that varies in width from approximately 250 to 500 feet. The banks of the Rillito River are characterized by steep soil cement walls. The river bottom consists of small, incised channel with sand, and the typical vegetation community is Sonoran interior strand mixed scrub series, consisting of small scrub, shrubs, and weeds. A prominent feature along the river is utility poles, sometimes running directly down the center of the river. Some visible degradation of the area exists where debris (household trash, tires, and other small items such as bottles and cans) have been deposited along the river bottom. Along the banks of the Rillito are pedestrian trails for recreation with a railing that separates the trails from the soil cement banks. Photograph 4.5-10 shows a pedestrian bridge, part of the trail system, along the bank of the Rillito River. The trail along the north bank is paved, while the trail along the south bank is gravel. In many places along the river there are access ramps that permit passage from the pedestrian trails to the river bottom. Several pedestrian bridges connect the trail where washes empty into the Rillito River.

PHOTOGRAPH 4.5-9

**View east of the study area from Craycroft Road Bridge, view is of the confluence of Tanque Verde Creek and Pantano Wash**

PHOTOGRAPH 4.5-10

**View of trail and pedestrian bridge along the north bank of the Rillito River**

RECON

In general, areas adjacent to the river include some natural vegetation communities such as Sonoran desert scrub and Sonoran riparian deciduous forest, mesquite series, as well as a few recreation venues with lighted fields and courts, rural-type private properties with horses, higher density homes including apartments and trailers, a few small businesses, and University of Arizona research area. In general, the area north of the Rillito River is less densely developed than the area south of the river. Major washes that empty into the Rillito River along the study site include Campbell, Camino Real, Finger Rock, Valley View, Flecha Caida, and Craycroft washes along the north, which are in a natural state, and Christmas, Alvernon, and Alamo washes along the south, which are channelized and cemented.

### 4.5.2.6 Campbell Road at River Crossing

Photograph 4.5-11 shows the view from Campbell Avenue, which is open, and the channel is approximately 350 feet wide (106 meters). The riverbanks are soil cement, with pedestrian trails along the riverbank and ramps for access to the riverbed. The riverbed is quite bare, dry and sandy, and sparsely vegetated with small, scattered shrubs. Adjacent land uses include a hotel to the north and the University of Arizona Agriculture Pima County Extension to the south. Utility poles run along the south side of the riverbed.

Draft

### 4.5.2.7 Dodge Road at River Crossing

The view from Dodge Road at the river crossing ranges from approximately 300 to 350 feet wide, with soil cement banks. Photograph 4.5-12 shows the view to the west, where the riverbed has utility poles that connect to the transformer station on the south bank of the river. To the east, as seen in Photograph 4.5-13, the utility poles continue along the center of the riverbed amid scattered strand vegetation. Adjacent land uses along the south river bank include the transformer station, and a trailer park with tall eucalyptus trees to the east, and recreation fields to the east, along with Alvernon Wash. The riverbend area lies to the north, and to the east is Mehl Park and the Jewish Community Center, which have recreational facilities. The mesquite bosque vegetation community surrounds Mehl Park facilities. To the west of Dodge Boulevard along the north bank in the river bend area is an area of low-density houses, many with horses. Finger Wash joins the Rillito River in the river bend area.

### 4.5.2.8 Swan Road at River Crossing

The river channel at Swan Road is wider than at Campbell Road and Dodge Boulevard, approximately 500 feet, as seen in Photograph 4.5-14. The view of the riverbed is similar to views from Campbell Road and Dodge Boulevard, with soil cement banks, dry sandy river bottom and scattered shrubs and weeds. Adjacent land uses along the south bank in the Swan Road vicinity include the Swan Corporate Center to the east of Swan Road, and apartment buildings to the east. Along the north bank to the west of Swan Road are more

PHOTOGRAPH 4.5-11

**View of Rillito River from Campbell Avenue Bridge looking east**

PHOTOGRAPH 4.5-12

**View of Rillito River from Dodge Boulevard Road looking west**

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PHOTOGRAPH 4.5-13

**View of Rillito River from Dodge Boulevard Road looking east**

PHOTOGRAPH 4.5-14

**View of Rillito River from Swan Road looking east**

RECON

apartment buildings. Photograph 4.5-15 shows the view to the east of the Swan Road bridge. There are two wetland areas by the apartment buildings on the south bank of the river that are separated where Alamo wash empties into the Rillito River. A pedestrian bridge spans Alamo Wash, connecting the trail. There are park facilities for recreation enthusiasts who use the river trails on both the south and north banks of the river. The utility line in this area runs along the north bank of the river, rather than in the riverbed. Along the north bank of the river to the east is an area of mesquite bosque vegetation.

### 4.5.2.9 Craycroft Road at River Crossing

Photograph 4.5-16 shows the view west of Craycroft Road bridge. The bridge is the eastern boundary of the study site, and the photograph shows the view to the west, looking towards the study site. The previous photograph (see Photograph 4.5-15) shows the view east of the bridge, beyond the study site boundary, looking at the confluence of Tanque Verde Creek, and Pantano Wash, where the Rillito River begins. The view to the west is of a bare riverbed, with some Sonoran interior strand vegetation along the northern bank of the river. The river channel is quite wide in this area, over 500 feet, where Craycroft Wash empties into the Rillito River. A pedestrian bridge spans Craycroft Wash connecting the trail. The utility poles in this area run in the center of the river on the riverbed. There are small areas of mesquite bosque along both the north and south banks. Within the mesquite bosque area along the north bank, there is a house that is currently being used as part of the Pima County Sherriff's operation. To the east of the area, beyond the study site boundary, is the confluence of the Tanque Verde River and Pantano Wash. The soils cement ends, and the overall view is of a more natural area with vegetation.

Draft

## 4.5.3 Regulatory Setting

While there appears to be no obvious regulations that directly apply to aesthetics resources, regulations, plans, goals, and policies are discussed below that may somehow relate to aesthetic resources and may be pertinent to the El Rio Antiguo study area.

**Pima County Comprehensive Plan and Conservation Lands System.** The Environmental Element of the Pima County Comprehensive Land Use Plan was adopted by the Board of Supervisors in December of 2001. The purpose of the Conservation Lands System is to ensure the long-term survival of the full spectrum of plants, animals, and biological communities that are indigenous to the county. The Conservation Lands System is designed to protect natural resources according to their biological value. This policy guidance ensures that land use proposals that require legislative consideration by the Board of Supervisors conforms with the intensity and quality standards that is appropriate for the protection of existing natural and cultural resources. The Conservation Lands System identifies the Rillito River is as an important riparian area.

PHOTOGRAPH 4.5-15

**View of Rillito River from Swan Road looking west**

PHOTOGRAPH 4.5-16

**View of Rillito River from Craycroft Road looking east**

RECON

The Conservation Lands System includes the following guidelines for that may relate to aesthetic resources:

- Important riparian areas are those areas defined by meso-riparian and xero-riparian vegetation, higher water availability, denser vegetation, and high biological productivity. Riparian areas are important elements in the Conservation Lands System and every effort should be made to protect, restore, and enhance the structure and functions of these areas, including hydrological, geomorphic, and biological functions.

According to the Conservation Lands System, every effort should be made to protect natural areas in the Rillito River from further degradation, and to restore and enhance the existing natural resources where possible. Specific guidelines pertaining to the Conservation Lands System for areas designated as important riparian areas include:

- Retain riparian areas in their natural state. At least 95 percent of the existing natural resources, including all riparian linkage areas and all washes with a discharge value of 250 cubic feet per second or larger.

This affects the El Rio Antiguo study area in that further degradation to the biological resources of the river would be prevented. In addition, restoration and enhancement of the biological resources is encouraged. Aesthetic resources relate to biological resources in that a healthy, natural ecosystem is generally more aesthetically pleasing than a degraded ecosystem devoid of flora and fauna. It is important to acknowledge that nothing in the Conservation Lands System guidelines shall alter, modify, decrease or limit the existing land uses, zoning, permitted activities, or management of lands within the Conservation Lands System. The Pima County Comprehensive Plan applies to those lands under control of Pima County, which would affect the Rillito River portion of the El Rio Antiguo study area and the area to the north.

Draft

## 4.5.4 References

Pima County
2001 Pima County Comprehensive Plan Update. December.

# 4.6 Recreation Resources

## 4.6.1 Introduction

This section describes the existing recreation resources, conditions, and opportunities in the study area. A series of photographs has been included in Section 4.5, Aesthetic Resources to illustrate the conditions in the study area, particularly along the river corridor. In addition, a descriptive overview of the recreational resources and setting of the Tucson area, as well as the vicinity of the study area is provided. Regulations, plans, goals, and policies related to recreation resources that may be pertinent to the study are also discussed. Other descriptive details on the physical conditions that influence the recreational character of the study area can be found in Sections 4.1, Topography and Geography; 4.2, Hydrology and Water Resources; 4.3, Biological Resources; 4.4, Land Use, and 4.5, Aesthetics.

## 4.6.2 Environmental Setting

draft

### 4.6.2.1 Regional Setting

The physical landscape, climatic characteristics, and diversity of biotic communities form the basis for the unique opportunities for recreation in Pima County. The dramatic landscapes vary from the 2,400-foot desert basin to the 9,100-foot forests of the Santa Catalina Mountains. The clear, sunny skies, pleasant winters, and great natural beauty of southern Arizona are highly conducive for outdoor recreation. The combination of dry desert air and winter sunshine has also made the area a popular health and winter resort. The remarkable scenery and climate in the Tucson area is striking not only to visitors, but to long-time residents as well.

Many recreation opportunities are available on the public lands found within Pima County. Outdoor recreational activities offered include wildlife viewing, hiking, equestrian trails, skiing, mountain biking, fishing, off-highway vehicle driving, and camping.

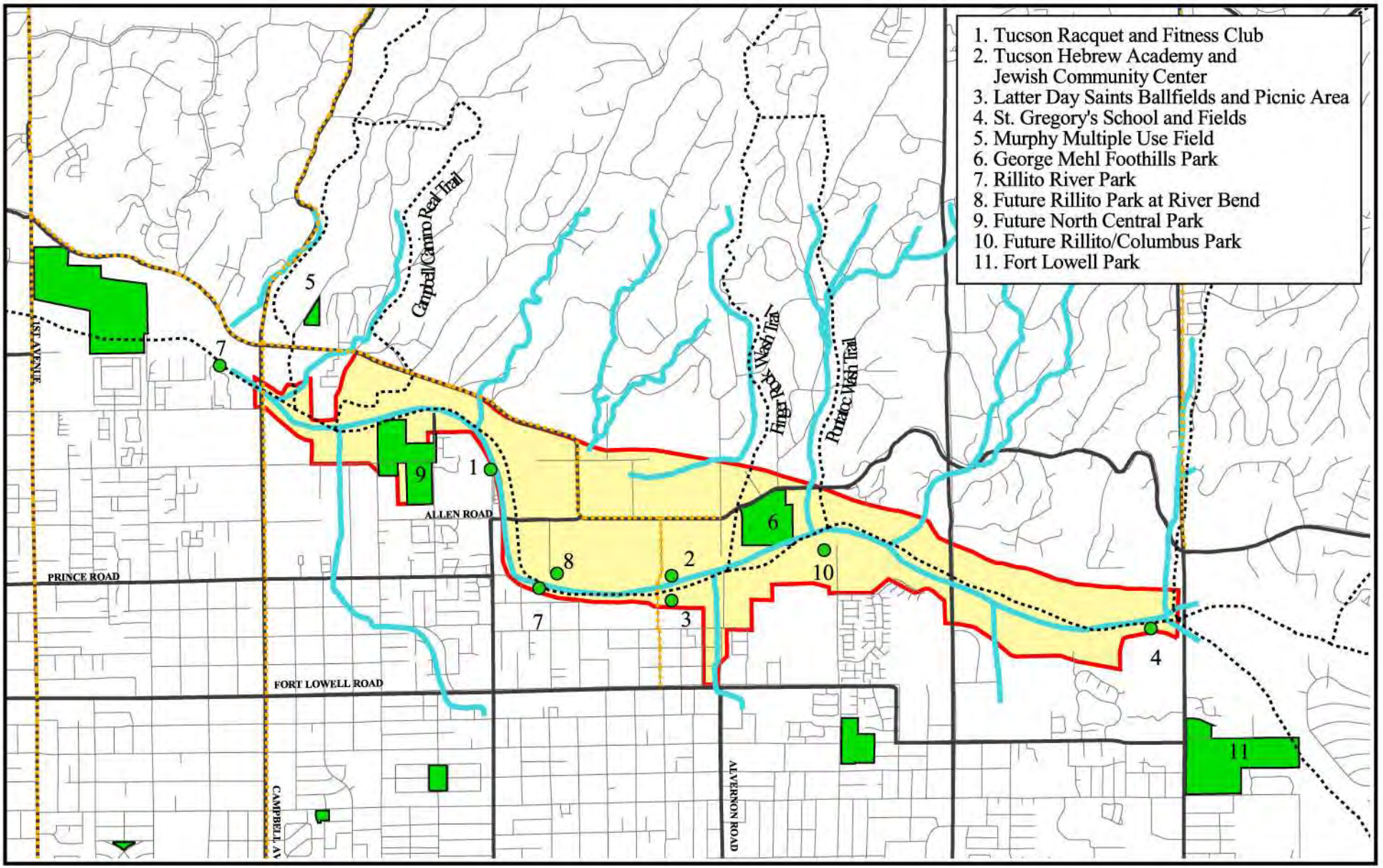
### 4.6.2.2 Study Area Setting

Within the study area there are a number of recreation facilities and parks, including the linear Rillito River Park. Both private and public parks are present. Within or adjacent to the study area, there are four existing public parks and recreation areas, and several planned public parks, along with four private facilities that offer recreational opportunities and facilities. These facilities are listed in Table 4.6-1 with a brief description and shown in Figure 4.6-1. For a complete list of County and City parks in

**TABLE 4.6-1**
**PRIVATE AND PUBLIC RECREATIONAL FACILITIES IN EL RIO ANTIGUO STUDY AREA**

| Facility | Use |
|---|---|
| Rillito River Park | This park is part of a larger trail system that will eventually connect with the Santa Cruz River, Canada del Oro Wash, Tanque Verde Creek, and Pantano Wash. This river park system will eventually function as one large unified trail system. Amenities include a bike and walking paths, trail system, parking facilities, water fountains, restrooms, and limited equestrian opportunities. |
| Rillito Park at River Bend | This park is currently being planned along the future realignment of River Road, north of the Rillito River. This park will provide 44 acres of a passive recreation natural. The park will have equestrian facilities such as staging areas and trails. Other features include caretakers quarters, administration buildings, art gallery, passive turf areas, ramadas, restrooms, picnic areas, maintenance buildings, orchards, and parking. |
| Murphey Multi-use Field | North of the Rillito River, this ball field complex offers baseball, softball, and soccer fields, although there is no direct or adjacent access to the Rillito River Park from these ball fields. |
| George Mehl Foothills District Park | The 35-acre park has recreational facilities including lighted baseball fields, lighted soccer field, restrooms, playground, and reservable ramadas. The path along the top of the soil cement bank of the River is immediately adjacent to and accessible from the park's south boundary and ball fields. In addition, the Tucson Girls' Chorus has its office and center here. |
| Fort Lowell Park | Fort Lowell Park has ball fields, tennis courts, racquetball and volleyball courts, a swimming pool, playground, picnic areas, ramadas, and an exercise course and center. Other facilities include public restrooms, concessions, and drinking fountains. This 60-acre park is operated by the City of Tucson and is located on Craycroft Road, south of the Rillito River |
| North Central Natural Resources Park | This park is being planned for the north end of Tucson Boulevard, south of the Rillito River. This 55-acre park will be operated by the City of Tucson and will have a small parking area, informal turf areas, trail systems, picnic facilities, playground, staging areas, and natural vegetation. |
| Rillito Park at Columbus Boulevard District Park | This park is planned for the north end of Columbus Boulevard near the south bank of the Rillito River. Plans for the park include recreational features such as ball fields, walking path, jogging area, off-leash dog area, playground, and picnic area. This location is particularly significant in the context of the study area because it is adjacent to a portion of the Rillito River where there is no soil cement bank and where the vegetative communities include remnants of riparian trees and other vegetation. This park will be operated by the City of Tucson. |
| Tucson Racquet and Fitness Club | Located at Country Club Road along the south bank of the Rillito River, this private facility has outdoor swimming pools, numerous tennis courts, and indoor fitness facilities. Members of the club use the adjacent Rillito River path for walking, jogging, and bicycling. Part of the Club's summer program includes outdoor concerts, the music of which can be heard from the riverbed and banks. |
| Tucson Hebrew Academy and Jewish Community Center (JCC) | Located at the northwest corner of Dodge Boulevard and the Rillito River, these joint facilities include several outdoor swimming pools, lighted ball fields, and tennis courts. The Rillito River path is used by students, faculty, and members of the JCC. |
| Recreation Area for the Church of Latter Day Saints | This private church park is located immediately south of the JCC, abutting the south bank of the Rillito River. There is a small picnic area and three lighted ball fields. This facility also has direct access to and from the path along the top of the soil cement bank. |
| Saint Gregory College Preparatory School | This is a private school located south of the Rillito River by Craycroft Road. There are two ball fields and tennis courts along the south bank of the River. Access to and from the path along the south bank is restricted for security purposes. |

SOURCE: Economics Report for the Feasibility Report for El Rio Antiguo, Tucson, Arizona (see Appendix H).

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Study area
Major Streets
Minor Streets
Recreation Facilities
Bike Path
Trail
Wash

# FIGURE 4.6-1
## Recreation Resources

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the Pima County/Tucson metropolitan area, please see Appendix H, Economics Report for the Feasibility Report for El Rio Antiguo, Tucson, Arizona.

In addition to the public parks and private facilities, there are several pedestrian and equestrian trails that follow foothills washes down to connect with the Rillito River and the study area. Major washes that empty into the Rillito River along the study site include Campbell, Camino Real, Finger Rock, Valley View, Flecha Caida, and Craycroft washes along the north, which are in a natural state, and Christmas, Alvernon, and Alamo washes along the south, which are channelized and cemented. Historically, these washes have provided important pedestrian and equestrian routes to and from the river from adjacent areas. Pontatoc Trail, Finger Rock Wash Train, and Campbell/Camino Real Trail are all in the study area and are part of the Pima County Trails Master Plan.

### 4.6.2.3 Population Growth and Recreation Demands

Tucson, along with Arizona and the Southwest, is one of the fastest growing regions in the United States. Pima County's population has grown over 135 percent since 1970, and is approximately 844,000. Due to this population growth, many public lands and recreation areas are surrounded by housing developments and other urban development. As the population increases, so are people's expectations and demand for recreational areas. In addition, the community is emphasizing the need to protect natural areas and develop more natural resource parks. This demand requires a new approach in planning for recreation needs—an approach that establishes and connects resource lands throughout the basin and strives to find a balance in the diverse demands that often compete for the same limited resource of land.

Draft

The proposed riparian habitat area along the El Rio Antiguo study area is attractive in terms of recreation potential and unmet demand for many reasons. These reasons include recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental considerations.

The Rillito River area offers potential exceptional opportunities for recreation experience. Proposed general recreation activities for the study area include trails for hiking, biking, and jogging. Horseback riding is also available at the park and is considered a high-quality activity. These fast-growing activities are ranked very high among the community and have a significant unmet demand.

The Rillito River area offers a unique, available opportunity to provide current and future recreation opportunities. In the past demand for trail opportunities was fulfilled by Pima County's many back-country and equestrian trails. But, as the County continues to grow, the demand has increased for urban trails and other recreation opportunities closer to home. According to *Arizona Trails 2000*, published under the authority of the Arizona

State Parks Board, the number one reason given by trail users for preferring a particular area is its proximity to home.

The Rillito River area has the potential to meet the recreation demands of a growing population in terms of carrying capacity. Pima County has experienced rapid population growth as well as an increased demand for recreational facilities. Currently, facilities at the park are adequate; however, as the population grows, the Rillito River area has the potential to provide more facilities to accommodate the demand.

The Rillito River area ranks high for accessibility. There are several major roadways and trails that intersect the study area. This provides a park area in high demand with access not only by automobile but also by pedestrians and equestrians.

Of all the parks in the vicinity of the study area, there are no significant thriving riparian areas. The Rillito River area retains several small pockets of riparian vegetation such as cotton-willow; however, most are declining remnants that are significantly degraded and not considered to be a thriving habitat for plants and animals. Other parks in the area have desert terrain and are not in riparian areas. This lack of riparian habitat is expected to result in significant unmet recreational demand. The Rillito River area has the potential to not only provide future recreation areas, but, with restoration efforts, the area can provide a significant riparian area to be enjoyed by recreationalists as well as wildlife.

Draft

One method of assessing community demand and the need for open space and recreation is the use of population-based standards. These standards are set by the National Recreation and Parks Association (NRPA) and are discussed in detail in Appendix H, Economics Report the Feasibility Report for El Rio Antiguo, Tucson , Arizona.

In general, the recreation analysis in Appendix F indicates that there is a lack of sufficient recreation resources for all types of parks. Table 4.6-2 shows the acres of park needed to fill demand in 2010 by facility type. The estimated number of park acres needed to fill demand by 2010 is 2,480. Also, an estimate of 27.53 miles of multi-use path is needed by 2010 to meet anticipated population growth.

### 4.6.2.4 Recreational Value

One method of assigning value to recreation resources is the Unit Day Value (UDV) method. The method uses administratively set dollar values to determine the worth of recreational experiences and calculates the value of recreation. Detail of this analysis for the Rillito River area are discussed further in Appendix H, Economics Report for the Feasiblity Report for El Rio Antiguo, Tucson, Arizona.

**TABLE 4.6-2**
**EXISTING AND FUTURE PARK DEMANDS**

| Facility Type | Park Size (acres) | Service Radius | Future 2010 Core/Mid-City (acres) | Future 2010 Edge/Future City (acres) | Future 2010 Total (acres) | 2001 Existing (acres) | Acres of Park Needed to Fill Demand in 2010 |
|---|---|---|---|---|---|---|---|
| Mini park | 0-1 | ¼ mile | N/A | N/A | N/A | 5 | N/A |
| Neighborhood park | 1-15 | ½ mile | 1,041 | 366 | 1,408 | 515 | 893 |
| Community park | 15-40 | 1 mile | 1,250 | 439 | 1,689 | 504 | 1,185 |
| Metro park | 40-200 | 2 ½ miles | 1,250 | 513 | 1,762 | 1,450 | 312 |
| Regional park | >200 | 7 miles | 417 | 293 | 709 | 619 | 90 |
| TOTAL | - | - | 3,957 | 1,611 | 5,568 | 3,093 | 2,480 |
| Multi-Use Path | - | - | 27.77 miles | 9.76 miles | 37.53 miles | 10.00 miles | 27.53 miles |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

In general, the UDV for 2002 can range from $2.90 to $8.69 per recreation day. The estimated UDV for Rillito River Park is approximately $4.45. This UDV amount represents how much a visit to the park is worth in dollar amount. Annual visitation for the Rillito River Park at Campbell Avenue is estimated to be 51,212 for 1999 and 2000. When multiplied with the estimated UDV, $4.45, the estimated annual value of recreation is approximately $227,890 for Rillito River Park at Campbell Avenue, which is only a portion of the park.

# 4.6.3 Regulatory Setting

Regulations, plans, goals, and policies related to aesthetic resources that may be pertinent to the El Rio Antiguo study area are described below.

## 4.6.3.1 Pima County Comprehensive Plan and Conservation Lands System

The Environmental Element of the Pima County Comprehensive Land Use Plan was adopted by the Board of Supervisors in April 2002. It incorporates by reference the Conservation Lands System, which is the Biological Resources component of the Sonoran Desert Conservation Plan. The Conservation Lands System is designed to protect natural resources according to their biological value and specifically identifies the Rillito River as an important riparian area. Important riparian areas are those areas defined by meso-riparian and xero-riparian vegetation, higher water availability, denser vegetation, and high biological productivity. These areas are considered to have a higher value in terms of biological and visual resources, both of which are inextricably linked to higher recreational values.

According to the Conservation Lands System guidelines, every effort should be made to protect natural areas in the Rillito River from further degradation, and to restore and enhance the existing natural resources where possible. Specific guidelines pertaining to the Conservation Lands System for areas designated as important riparian areas include:

- Retain riparian areas in their natural state. At least 95 percent of the existing natural resources, including all riparian linkage areas and all washes with a discharge value of 250 cubic feet per second or larger.

This affects the El Rio Antiguo study area in that further degradation to the biological resources of the river would be prevented. Furthermore, restoration and enhancement of the biological resources is encouraged. Recreation resources relate to biological resources in that a healthy, natural ecosystem is generally more aesthetically pleasing than a degraded ecosystem devoid of flora and fauna. It is important to acknowledge that nothing in the Conservation Lands System guidelines shall alter, modify, decrease or

limit the existing land uses, zoning, permitted activities, or management of lands within the Conservation Lands System. The Pima County Comprehensive Plan applies to those lands under control of Pima County, which would affect the Rillito River portion of the El Rio Antiguo study area and the area to the north.

### 4.6.3.2 City of Tucson General Plan, "Livable Tucson Vision" Program, and Parks and Recreation Master Plan 2010

The Tucson General Plan, adopted in November 2001, has two Elements that address recreation related issues:

#### a. Element 10: Parks, Recreation, Open Space and Trails and Element 14: Environmental Planning and Conservation

The Regional Vision for these Element 10 calls for an integrated system of parks, recreation, and open space that serves the needs of a population that is diverse in culture, age, and interests. The goal is to accomplish this by expanding traditional park facilities to balance active sports-oriented parks with more natural parklands and by developing miniparks along the linear park system. The Vision for Element 14 calls for the continued development of an interconnected network of open space, including parklands, washes, riparian habitats, and public preserves throughout the region.

Draft

In the spring of 1997, the Mayor and Council of the City of Tucson initiated the Livable Tucson Vision Program to identify a long-term, community-driven vision for Tucson that would help to shape the City's budget and provide a framework for developing programs and services that address the real concerns of the community. Included in that program are 17 "Livable Tucson Goals" which are considered valid indicators of a livable Tucson. Two of these livability goals, described below, specifically address concerns over recreation areas and recreation-related issues. Although these goals were developed prior to the adoption of the General Plan, they have been incorporated into and made part of the General Plan.

#### b. Livable Tucson Goals: Indicators of a Livable Tucson

**Abundant Urban Green Space and Recreation Areas.** Includes recreation and green space within the city, including neighborhood and regional parks, common space, community gardens, bike and walking paths, linear and river parks, trees, and urban landscaping.

**Protected Natural Desert Environment.** Includes protection of the Sonoran Desert ecosystem and protection of washes, hillsides, open space, and wildlife.

The ongoing development of the Tucson Parks and Recreation Master Plan 2010 supports these goals and identifies opportunities for implementation strategies. The purpose of the Parks and Recreation Master Plan 2010 is to produce a comprehensive plan for parks, recreation programs, and facilities. The plan will guide the City of Tucson to the year 2010 in meeting the leisure needs and demands of its citizens for urban green space and recreation areas. The design of the Northside Park, within this study area and adjacent to the south bank of the Rillito River, as a natural desert park is an example of the commitment to these goals. Success indicators identified for meeting these goals include the extent of preserved or restored urban washes and wildlife corridors, and the presence and diversity of key native wildlife species.

## 4.6.4 References

Pima County

1996 Eastern Pima County Trail System Master Plan, Revised Master Trails List. August.

2002 Pima County Comprehensive Plan Update, Sonoran Desert Conservation Plan and Conservation Lands System. April.

Tucson, City of

2001 General Plan Update. November.

n.d. Tucson Parks and Recreation Master Plan 2010.

U.S. Army Corps of Engineers

2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

U.S. Census Bureau

2002 Summary File 2 Data for Arizona, Year 2000. March.

Draft

# 4.7 Air Quality

## 4.7.1 Introduction

This section describes the existing climate, meteorology, and ambient air quality in the region of the study area, along with the regulatory requirements associated with the management of air pollutants.

## 4.7.2 Environmental Setting

### 4.7.2.1 Climate and Meteorology

The Tucson area is situated in a high desert valley surrounded by four mountain ranges. The Tucson Valley is flat, at approximately 2,400 feet (735 meters), and surrounded on the north by the Santa Catalina Mountains (approximately 9,100 feet or 2,770 meters), the south by the Santa Rita Mountains (9,400 feet or 2,860 meters), the east by the Rincon Mountains (8,480 feet or 2,580 meters), and the west by the Tucson Mountains (4,000 feet or 1,220 meters). Tucson experiences semi-arid conditions, with a climate that is characteristic of the Sonoran Desert. Summers are hot, with the highest temperatures occurring in June and July, while winters are mild, with the lowest temperatures occurring in December and January. The average precipitation is usually around 12 inches (30 cm) annually. Often there are intense, but brief thunderstorms during the summer monsoon season. Table 4.7-1 lists the average high, low, and average daily temperature by month, along with precipitation, for the years 1971 through 2000. Rainfall comes mostly during the summer monsoon season in July, August, and September, when regional weather patterns can induce thunderstorms virtually everyday.

Overall topography of the Tucson basin broadly influences normal wind patterns. Surface winds in the valley are influenced to a considerable extent by the adjacent mountains and by the slope of the valley floor. Under light pressure gradients, this effect is evident in the frequently noted change in wind direction from the southeast during the night and early morning hour then veering to the northwest during the warmer portion of the day. In general, the prevailing winds blow from the southwest at an average of about eight miles an hour.

### 4.7.2.2 Air Quality

The purpose of the Clean Air Act (CAA) is to maintain healthy air quality by controlling air pollution. The CAA identifies air pollutants and sets primary and secondary standards for each. The primary standard protects human health, and the secondary standard is based on potential environmental and property damage. An area that meets or exceeds the primary standard is called an attainment area; an area that does not meet the primary

**TABLE 4.7-1**
**MONTHLY HIGH, LOW, AND AVERAGE DAILY TEMPERATURE, AND PRECIPITATION MEASURES FOR TUCSON, 1971 TO 2000**

| Month | Normal Temperatures (in degrees Fahrenheit) | | | Normal Precipitation (in inches) |
|---|---|---|---|---|
| | High | Low | Average | |
| January | 64.5 | 38.9 | 51.7 | 0.99 |
| February | 68.4 | 41.6 | 55.0 | 0.88 |
| March | 73.3 | 45.1 | 59.2 | 0.81 |
| April | 81.5 | 50.5 | 66.0 | 0.28 |
| May | 90.4 | 58.6 | 74.5 | 0.24 |
| June | 100.2 | 68.0 | 84.1 | 0.24 |
| July | 99.6 | 73.4 | 86.5 | 2.07 |
| August | 97.4 | 72.4 | 84.9 | 2.30 |
| September | 94.0 | 67.7 | 80.9 | 1.45 |
| October | 84.0 | 57.0 | 70.5 | 1.21 |
| November | 72.3 | 45.1 | 58.7 | 0.67 |
| December | 64.6 | 39.2 | 51.9 | 1.03 |
| Annual | 82.5 | 54.8 | 68.7 | 12.17 |

SOURCE: National Oceanic and Atmospheric Administration
http://www.wrh.noaa.gov/Tucson/climate/tus.html

standard is called a non-attainment area. Typically, an area may exceed the standard a limited number of times within a given period before the area is in violation of the standard.

Under the CAA the U.S. Environmental Protection Agency (EPA) sets limits on how much of a pollutant can be in the air. In general, the federal government develops the regulations and the states carry them out. States can have stronger pollution controls, but states are not allowed to have weaker pollution controls than those set by the EPA. States are able to take the lead in carrying out the CAA because pollution control problems often require a special understanding of the local setting. States have to develop State Implementation Plans (SIPs) that explain how each state will do its job under the CAA, and the SIP must be approved by the EPA. A SIP is a collection of state and local regulations and plans to achieve healthy air quality and clean up polluted areas.

The Arizona SIP is a cumulative record of all air pollution strategies, nonattainment area plans (NAPs), statutes, rules, and ordinances implemented under the CAA, and is managed by the Arizona Department of Environmental Quality (ADEQ). ADEQ coordinates with Pima Association of Governments (PAG), Pima County Department of Environmental Quality (PDEQ) and Arizona Department of Transportation (ADOT) on regional air quality planning to develop and implement air pollution control programs directed at attaining and maintaining federal and state clean air standards. PDEQ and ADEQ monitor air quality to ensure that the County meets and maintains national standards. In addition, monitoring helps to define the nature and extent of air quality problems within a geographical area. The goal is to improve air quality by identifying air pollution problems, and to reduce the concentration of harmful air contaminants to safe levels.

Draft

### 4.7.2.3 Criteria Pollutants

Criteria pollutants can negatively affect health, harm the environment, and cause property damage. The EPA established regulations for six criteria pollutants by developing health-based criteria as the basis for setting permissible levels. The permissible levels are called the National Ambient Air Quality Standards (NAAQS). Primary standards protect human health, while secondary standards prevent environmental and property damage. Attainment areas are areas that meet the primary standard, while areas that do not meet the primary standard are called nonattainment areas. There are five classes of nonattainment areas ranging from marginal to extreme. Pima Department of Environmental Quality monitors the following pollutants: ground-level ozone (smog), carbon monoxide, particulate matter, nitrogen dioxide, sulfur dioxide, volatile organic compounds, air toxics (hazardous air pollutants, HAPS), odors, and regional haze and visibility impairment. PDEQ monitored lead until 1997. Due to the elimination of lead in gasoline, and the lack of any significant stationary point source lead emissions, monitoring for lead was discontinued in 1997 with permission for exemption from the

EPA. Criteria pollutants and their associated health and welfare effects are listed in Table 4-7.2. Current NAAQS are listed in Table 4-7.3.

### 4.7.2.4 Regional Overview

Two air planning areas have been designated in eastern Pima County. Figure 4.7-1 shows the general locations of the Rillito Air Planning Area, which spans the northwest portion of Pima County, and the Tucson Air Planning Area, which spans metropolitan Tucson and the surrounding area. PDEQ collects air quality information at 18 monitoring sites. ADEQ collects air quality information at monitors in the Rillito Planning Area. Figure 4.7-2 shows the location of the PDEQ air quality monitoring stations. It is important to note that designating air "areas" is somewhat arbitrary, and the boundaries are approximate. A designation has been made between air planning areas primarily because of $PM_{10}$ concerns in the Rillito Air Planning Area, and CO concerns in the Tucson Air Planning Area. The El Rio Antiguo study area is within the Tucson Air Planning Area.

Table 4.7-4 lists the air quality readings from the monitoring sites closest to the El Rio Antiguo study area, which lies within the Tucson Air Planning Area. It is important to note that the monitoring sites, Children's Park, Prince Road, and 22$^{nd}$ and Craycroft, were used to report the values of criteria pollutants. These monitoring sites were the closest to the El Rio Antiguo study area that reported the criteria pollutant values in the same manner as the NAAQS. For example, while the Cherry/Glenn monitoring site, which monitors carbon monoxide (CO), is closest to the El Rio Antiguo study area, it is a "special purpose" site that only monitors CO during the periods of January through April, and September through December, and only the maximum 8-hour average value is reported at this station. Therefore, CO values for both the maximum 1-hour and maximum 8-hour average values are reported from the 22$^{nd}$/Craycroft monitoring site, which coincides with NAAQS. Table 4.7-5 lists the range of air quality readings for each criteria pollutant at all applicable monitoring sites in the Tucson Air Planning Area. In an attempt to determine any air quality trends among the monitoring sites, the range of each criteria pollutant is given. For example, when all monitoring sites that measure CO are considered, the lowest maximum 1-hour average value for CO is 3.5 parts per million (ppm), and the highest maximum 1-hour average value is 8.9 ppm. This means that maximum 1-hour averages for CO are all within the 3.5 to 8.9 ppm range. One might expect high carbon monoxide readings at monitoring sites in close proximity to high traffic areas; however, the range reported revealed no apparent or consistent pattern. This does not imply that there are no trends or patterns, only that if one does exists, it is not apparent given the range of values for the criteria pollutants.

In the Tucson Air Planning Area, carbon monoxide is monitored at five sites in eastern Pima County. Tucson is currently in attainment for the CO criteria pollutant under the CO Limited Maintenance Plan as of July 2000. In 1984, the 8-hour standard of 9.0 ppm

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**TABLE 4.7-2**
**HEALTH AND WELFARE EFFECTS OF CRITERIA AIR POLLUTANTS**

| Pollutant | Health and Welfare Effects |
|---|---|
| Carbon Monoxide (CO) | The primary health effect from CO is depletion in the amount of oxygen in the blood that can reach the cells. Symptoms of high CO concentration include dizziness, slower reaction times, and headaches. The major source of CO is motor vehicle emissions. |
| Nitrogen Dioxide ($NO_2$) | High levels of $NO_2$ can irritate the respiratory system; however, the primary harm is from the ozone that it helps to form by reacting with atmospheric oxygen and volatile organic compounds. $NO_2$ is a yellow-brown gas that can limit visibility and increase urban haze. The major source of $NO_2$ is motor vehicles. |
| Particulate Matter ($PM_{10}$ and $PM_{2.5}$) | The primary health risk from particulate matter is from the particles that are inhaled and pass through the body's fine filtering system, posing a health risk. The health risk is influenced by the penetration and deposition of particles in the respiratory track, and by the biological responses to the deposited materials. Smaller particles often present a greater health risk because they can be deposited deeper in the respiratory system. Sources of particulate matter include traffic on unpaved roads, unpaved shoulders, and paved streets, combustion, earth-moving, mining, construction, and agricultural activities. |
| Ozone ($O_3$) | The primary health effect associated with ground-level ozone (not to be confused with stratospheric ozone) is impaired lung function and irritation of the mucous membranes in the nose and throat causing coughing and choking. Ozone can aggravate chronic respiratory diseases like asthma and bronchitis, and can irritate eyes. Sources of ozone include motor vehicles, smokestacks, cars, paints, and solvents. |
| Sulfur Dioxide ($SO_2$) | Many types of respiratory diseases are associated with high levels of $SO_2$ including coughs, colds, asthma and bronchitis. At high concentrations, $SO_2$ can impair visibility. In the past, the major source of $SO_2$ was copper smelters. A reduction in the number of smelters and technological improvements in pollution controls have substantially reduced $SO_2$ emissions. |

**TABLE 4.7-2**
**HEALTH AND WELFARE EFFECTS OF CRITERIA AIR POLLUTANTS**
**(continued)**

| Pollutant | Health and Welfare Effects |
|---|---|
| Lead | The primary health effect from lead is damage to the cardiovascular, renal, and nervous systems, resulting in anemia, brain damage, and kidney disease. In the past, a source of lead was from gasoline in automobile engines. Due to the elimination of lead in gasoline, and the lack of any significant stationary point source lead emissions, monitoring for lead was discontinued in Pima County in 1997, with permission for exemption from the EPA. |

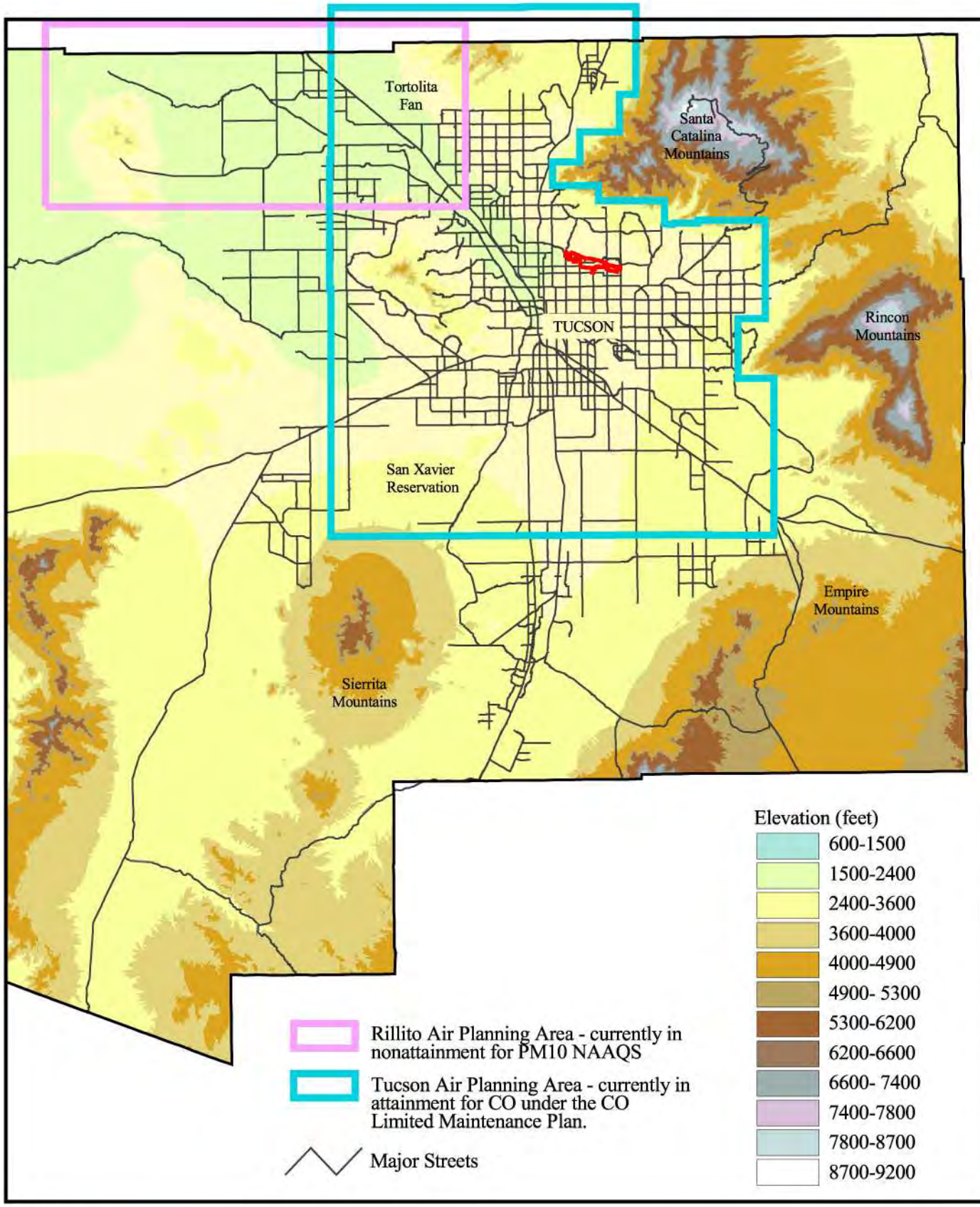
SOURCE: Air Quality in Pima County, February 2001.

**TABLE 4.7-3**
**NATIONAL AMBIENT AIR QUALITY STANDARDS**

| Pollutant | Average Time | Primary Standard | Secondary Standard |
|---|---|---|---|
| Carbon Monoxide (CO) | 1-hour Average | 35.00 ppm (40 $mg/m^3$) | NS |
| | 8-hour Average | 9.00 ppm (10 $mg/m^3$) | NS |
| Nitrogen Dioxide ($NO_2$) | Annual Arithmetic Mean | 0.053 ppm (100 $\mu g/m^3$) | 0.053 ppm (100 $\mu g/m^3$) |
| Particulate Matter (PM 10) | 24-hour Average | 150 $\mu g/m^3$ | 150 $\mu g/m^3$ |
| | Annual Arithmetic Mean | 50 $\mu g/m^3$ | 50 $\mu g/m^3$ |
| Ozone ($O_3$) | 1-hour Average | 0.12 ppm (235 $\mu g/m^3$) | 0.12 ppm (235 $\mu g/m^3$) |
| Sulfer Dioxide ($SO_2$) | 3-hour Average | NS | 0.50 ppm (1300 $\mu g/m^3$) |
| | 24-hour Average | 365 $\mu g/m^3$ (0.14 ppm) | NS |
| | Annual Arithmetic Mean | 80 $\mu g/m^3$ (0.03 ppm) | NS |
| Lead (Pb) | Calendar Quarter | 1.5 $\mu g/m^3$ | 1.5 $\mu g/m^3$ |

SOURCE: US Environmental Protection Agency website www.epa.gov.

NS = No Standard
Ppm = Parts per million
$\mu g/m^3$ = Micrograms per cubic meter

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El Rio Antiguo study area

0 Miles 10

# FIGURE 4.7-1
## General Location of the Tucson and Rillito Air Planning Areas

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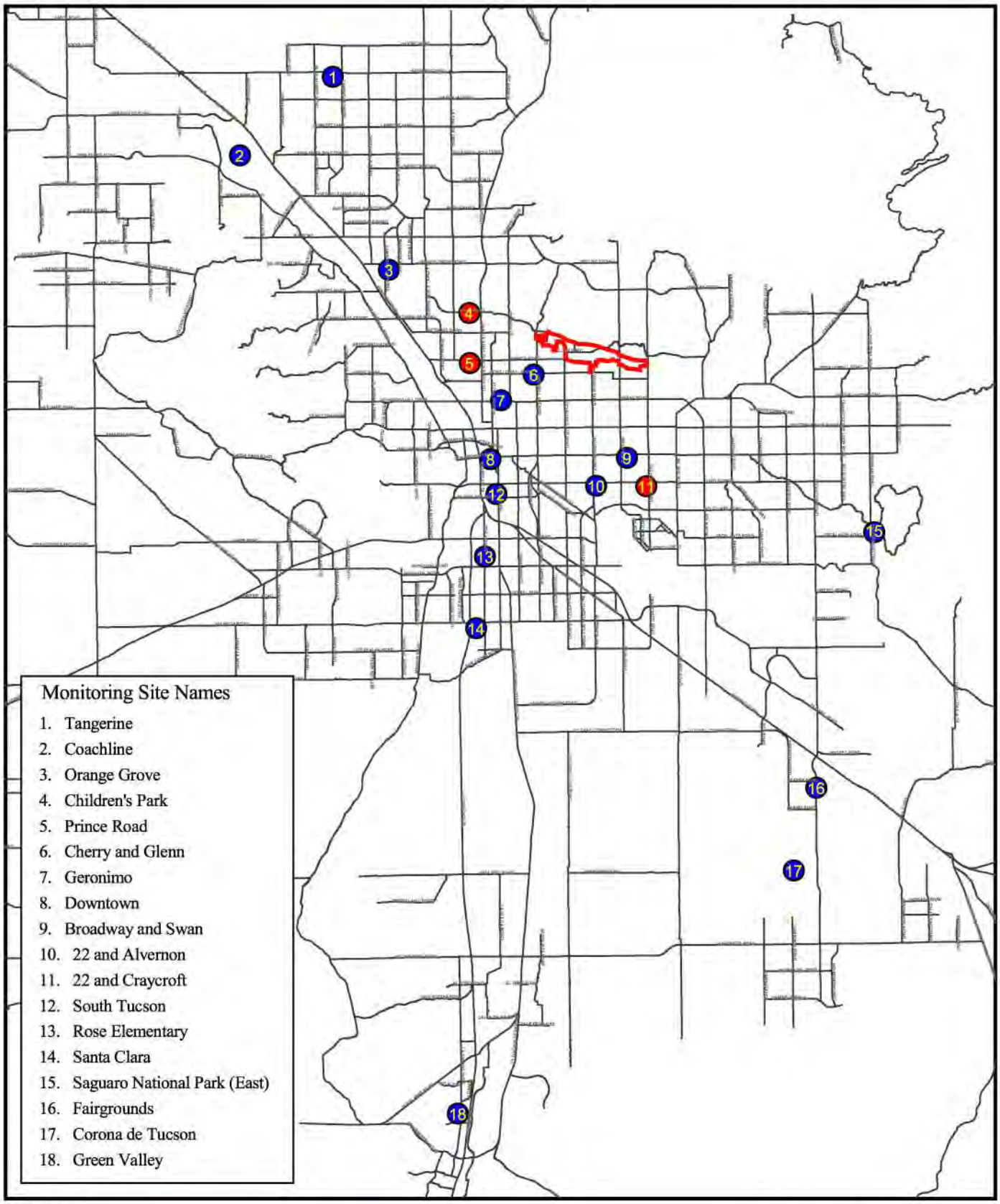


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El Rio Antiguo study area

0 Miles 5

Air monitoring sites

Air monitoring sites - used to report NAAQS criteria pollutant values for 1998 through 2001 for the El Rio Antiguo study area

(Source: Pima County Department of Environmental Quality)

# FIGURE 4.7-2
## Pima Department of Environmental Quality (PDEQ) Air Quality Monitoring Stations

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**TABLE 4.7-4**
**AIR QUALITY MONITORING SUMMARY FOR AIR MONITORING STATIONS IN THE VICINITY OF EL RIO ANTIGUO STUDY SITE AREA**

| Pollutant Standards | NAAQS | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| Carbon Monoxide (CO) Standard[1] | | | | | |
| Maximum 1-hour Average (ppm) | 35.0 | 4.8 | 5.4 | 5.4 | 3.7 |
| Maximum 8-hour Average (ppm) | 9.0 | 2.6 | 2.3 | 2.7 | 1.9 |
| Nitrogen Dioxide ($NO_2$) Standard[2] | | | | | |
| Maximum 1-hour Average ($\mu g/m^3$) | -- | 0.061 | 0.070 | 0.062 | 0.058 |
| Maximum 24-hour Average ($\mu g/m^3$) | -- | 0.036 | 0.036 | 0.033 | -- |
| Annual Average ($\mu g/m^3$) | 0.053 | 0.016 | 0.019 | 0.016 | 0.0157 |
| Particulate Matter (PM 10) Standard[3] | | | | | |
| 24-hour Maximum Value ($\mu g/m^3$) | 150 | 88 | 118 | 68 | 125 |
| Annual Average ($\mu g/m^3$) | 50 | 35 | 44 | 38 | 33 |
| Ozone ($O_3$) Standard[2] | | | | | |
| Maximum 1-hour Average (ppm) | 0.12 | 0.086 | 0.092 | 0.094 | 0.084 |
| Annual Average (ppm) | -- | 0.026 | 0.027 | 0.026 | 0.05 |
| Sulfur Dioxide ($SO_2$) Standard[1] | | | | | |
| Maximum 3-hour Average (ppm) | 0.50 | 0.016 | 0.012 | 0.011 | -- |
| Maximum 24-hour Average (ppm) | 0.14 | 0.005 | 0.005 | 0.008 | 0.003 |
| Annual Average (ppm) | 0.03 | 0.002 | 0.002 | 0.002 | 0.001 |
| Lead (Pb) | | | | | |
| Calendar Quarter Average ($\mu g/m^3$) | 1.5 | NM | NM | NM | NM |

SOURCE: Pima County Department of Environmental Quality 2000 Air Quality Summary Report (AQ-332) and Appendix (AQ-333). 2002 data from Deborah Jentoft, PDEQ.

NOTE: While the Cherry/Glenn monitoring site, which monitors CO, is closer to the El Rio Antiguo study area, it is a "special purpose" site that only monitors CO during the periods of January through April, and September through December. In addition, only the maximum 8-hour average is reported from this station. Therefore, CO values for both the maximum 1-hour and maximum 8-hour averages are reported from the 22nd/Craycroft monitoring site.

[1]22nd/Craycroft monitoring station
[2]Children's Park monitoring station
[3]Prince Road monitoring station

NM = Not monitored

ppm = parts per million parts of air, by volume

$\mu g/m^3$ = micrograms per cubic meter of air

**TABLE 4.7-5**
**AIR QUALITY MONITORING SUMMARY FOR THE TUCSON AIR PLANNING AREA**

| Pollutant Standards* | NAAQS | 1998 | 1999 | 2000 |
|---|---|---|---|---|
| Carbon Monoxide (CO) Standard | | | | |
| Maximum 1-hour Average (ppm) | 35.0 | 4.6 - 7.8 | 3.0 - 10.6 | 3.5 - 8.9 |
| Maximum 8-hour Average (ppm) | 9.0 | 2.3 - 4.3 | 1.9 - 4.3 | 1.9 - 5.0 |
| Nitrogen Dioxide ($NO_2$) Standard† | | | | |
| Maximum 1-hour Average ($\mu g/m^3$) | -- | 0.059 - 0.061 | 0.063 - 0.070 | 0.062 - 0.075 |
| Maximum 24-hour Average ($\mu g/m^3$) | -- | 0.036 - 0.037 | 0.036 | 0.033 - 0.035 |
| Annual Average ($\mu g/m^3$) | 0.053 | 0.016 - 0.017 | 0.018 - 0.019 | 0.016 - 0.017 |
| Particulate Matter (PM 10) Standard | | | | |
| 24-hour Maximum Value ($\mu g/m^3$) | 150 | 31 - 96 | 41 - 235 | 63 - 142 |
| Annual Average ($\mu g/m^3$) | 50 | 15 - 39 | 18 - 44 | 17 - 38 |
| Ozone ($O_3$) Standard | | | | |
| Maximum 1-hour Average (ppm) | 0.12 | 0.078 - 0.104 | 0.078 - 0.095 | 0.076 - 0.089 |
| Annual Average (ppm) | -- | 0.018 - 0.042 | 0.019 - 0.041 | 0.018 - 0.037 |
| Sulfur Dioxide ($SO_2$) Standard† | | | | |
| Maximum 3-hour Average (ppm) | 0.50 | 0.016 | 0.012 | 0.011 |
| Maximum 24-hour Average (ppm) | 0.14 | 0.005 | 0.005 | 0.008 |
| Annual Average (ppm) | 0.03 | 0.002 | 0.002 | 0.002 |
| Lead (Pb) | | | | |
| Calendar Quarter Average ($\mu g/m^3$) | 1.5 | NM | NM | NM |

SOURCE: Pima County Department of Environmental Quality 2000 Air Quality Summary Report (AQ-332) and Appendix (AQ-333). 2002 data from Deborah Jentoft, PDEQ.

**TABLE 4.7-5**
**AIR QUALITY MONITORING SUMMARY FOR THE TUCSON AIR PLANNING AREA**
**(continued)**

*Range reported includes all monitoring stations.

†$SO_2$ is monitored at only one location, 22nd/Craycroft monitoring station.

NM = Not monitored

ppm = parts per million parts of air, by volume

$\mu g/m^3$ = micrograms per cubic meter of air

was violated. In response, PDEQ developed a CO Limited Maintenance Plan that was approved by the EPA in April of 2000. The CO Limited Maintenance Plan will be in effect for ten years, and may be renewed in eight years. In addition, PAG produces an annual CO Progress Report and conducts modeling analysis of on-road regional emissions and hot-spot levels. If a violation occurs, contingency measures outlined in the CO Limited Maintenance Plan will apply. PDEQ will monitor and notify ADEQ if CO levels exceed 85 percent of the 8-hour standard. There have been no violations of the CO standard since 1984. The Tucson Air Planning Area was considered to be in nonattainment until 2000, when the CO Limited Maintenance Plan was approved by the EPA, and there had been no more violations of the CO standard.

In the Tucson Air Planning Area, the NAAQS CO 1-hour average is 35.0 parts per million (ppm), and the 8-hour average is 9.0 ppm. For the past few years, the 1-hour CO levels in eastern Pima County ranged from 3.0 to 10.6 ppm for the 1-hour standard, and 1.9 to 5.0 ppm for the 8-hour standard. In the vicinity of the study area, the highest 1-hour level was 5.4 ppm, and the highest 8-hour level was 2.7 ppm at the 22$^{nd}$ and Craycroft site. The highest CO values in Tucson are normally observed immediately after rush hours. Tucson has experienced small pockets of high CO concentrations, known as "hot spots," usually near congested intersections, compared to larger metropolitan areas that exhibit a high degree of uniform CO concentrations over broad areas. Motor vehicle emissions contribute up to 70 percent of the air pollution in the Tucson area, and the quality of visibility and air is adversely affected by the emissions. Because of the use of cleaner burning oxygenated fuels, fuel-efficient computer-controlled vehicles, locally adopted Clean Air Programs, and various local traffic control measures, there is a declining trend for carbon monoxide. In general, levels of carbon monoxide remain around 40 percent of the national standard. However, with future population growth and more cars on the road, there will probably be an increase in future carbon monoxide levels.

Many years ago, in response to violation of the $PM_{10}$ standard, the Tucson and Rillito Air Planning Areas were distinguished. Due to activities in the northwest portion of eastern Pima County, including cement and mining operations, dirt roads, agriculture and field tilling operations, and land clearing, $PM_{10}$ standards were violated. The EPA and ADEQ conducted studies to determine the area that was in violation and of particular concern for $PM_{10}$. Subsequently, the Rillito and Tucson Air Planning Areas were designated. Since that time, the Rillito Air Planning Area has been in nonattainment of the $PM_{10}$ standard. In the Rillito Air Planning Area, since changes have been made to the cement and mining operations, dirt roads have been paved, and agriculture operations are now limited, there has been an overall decrease in $PM_{10}$ levels and the standard has not been violated in some time. However, the Rillito Air Planning Area is still considered to be in nonattainment for the $PM_{10}$ standard. Currently ADEQ has monitors in the Rillito Air Planning Area that record $PM_{10}$ levels. It is important to note that the nonattainment status applies only to the Rillito Air Planning Area, and does not affect the area in the

vicinity of the El Rio Antiguo study area. The El Rio Antiguo study area lies within the Tucson Air Planning Area.

In the Tucson Air Planning Area, particulate matter ($PM_{10}$) is monitored at nine sites. In 1999 the $PM_{10}$ 24-hour standard of 150 ppm was exceeded twice at the South Tucson site, and exceeded four times and subsequently violated at the Orange Grove site.

For the Tucson Air Planning Area, rather than go into non-attainment for $PM_{10}$, EPA has a Natural Events Policy that allows Pima County to develop a Natural Events Action Plan for $PM_{10}$. This documentation shows that the exceedances were the result of natural events due to high winds and drought. The Natural Events Action Plan (NEAP) is designed to implement the best available control measures (BACM) in the future during high wind and drought events, and conduct an outreach program for protection of public health. The NEAP process is less prescriptive than a nonattainment area plan. Pima County's NEAP is due to be implemented by December of 2002. Therefore, the Tucson Air Planning Area is still considered to be in attainment for $PM_{10}$.

The 24-hour NAAQS for $PM_{10}$ is 150 micrograms per cubic meter ($\mu g/m^3$). During 1998, in the Tucson Air Planning Area, the $PM_{10}$ level for 24 hours ranged from 31 to 96 ppm; however, in 2000 those levels ranged from 63 to 142 ppm. For the $PM_{10}$ annual average levels ranged between 15 and 44 ppm during 1998, 1999, and 2000. In the vicinity of the study area, the highest $PM_{10}$ 24-hour level was 125 ppm in 2002, and 44 ppm in 1999 for the annual average, both at the Prince Road site. Currently, the Tucson Air Planning Area is considered to be in attainment for the $PM_{10}$ NAAQS.

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Although $PM_{2.5}$ is not an official criteria pollutant, it is monitored at two sites in eastern Pima County that are in the Tucson Air Planning Area. The EPA proposed standards for $PM_{2.5}$ in 1997; however, due to a 1999 federal court ruling, the implementation of the $PM_{2.5}$ standards has been blocked. However, $PM_{2.5}$ is still monitored by PDEQ and reported for information purposes. The $PM_{2.5}$ concentrations in the Tucson area have not exceeded the recommended 24-hour NAAQS of 65 $\mu g/m^3$. The 24-hour $PM_{2.5}$ concentrations for 2000 are 13.6 ppm (Children's Park site) and 13.3 ppm (Orange Grove site), and for 1999 are 22.8 ppm (Children's Park site) and 56.2 ppm (Orange Grove site).

In the Tucson Air Planning Area, ozone is monitored at six sites. Currently, Pima County is in attainment of $O_3$. The NAAQS for the 1-hour average of $O_3$ is 0.12 ppm. From 1998 to 2000, 1-hour average $O_3$ levels ranged from 0.076 to .0104 ppm. In the vicinity of the study area the highest one-hour $O_3$ value was 0.094 ppm in 1999 at Children's Park monitoring site. Ozone levels are dependent on atmospheric conditions such as temperature, humidity, sunlight, and concentrations of two precursor pollutants, oxides of nitrogen ($NO_X$), and volatile organic compounds (VOC). Meteorology plays a critical role in $O_3$ formation and dispersion. Over the last several years, average measured ozone concentrations have remained relatively uniform throughout the area. Although the

ground level ozone concentrations are relatively steady, with the levels approaching, but not exceeding the NAAQS, there is reason for concern. As the population grows, a larger population tends to drive more, increasing pollutant emissions that can form ozone.

In the Tucson Air Planning Area, nitrogen dioxide, $NO_2$, is monitored at two sites. Currently, The Tucson Air Planning Area is in attainment for this criteria pollutant. This criteria pollutant has remained at low levels. The NAAQS annual average for $NO_2$ is 0.053 $\mu g/m^3$. Annual average readings in eastern Pima County range from 0.016 to 0.019 $\mu g/m^3$. The highest annual average in the vicinity of the study area was 0.019 $\mu g/m^3$ in 1999 at the Children's Park monitoring site. In general, the annual average is approximately 34 percent of the standard. There has been no significant change in the levels of this pollutant in the past 10 years.

Sulfur dioxide, $SO_2$, is monitored at one site in the Tucson Air Planning Area, and similar to $NO_2$, this pollutant has had no significant changes in the level during the past 10 years. Currently, the Tucson Air Planning Area is in attainment. The NAAQS annual average for $SO_2$ is 0.03 $\mu g/m^3$. The highest annual average for the past four years was 0.003 $\mu g/m^3$ in 2001 at the 22nd and Craycroft monitoring site. In general, the annual average is approximately 7 percent of the NAASQ level.

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Since 1986 when the EPA implemented regulation that reduced the amount of lead content of gasoline by 90 percent, measured lead levels have dropped considerably. The EPA has since focused its measurements for lead concentrations from mobile source emissions to stationary point sources of lead emissions. At the current time, Pima County has no significant sources of airborne lead pollution, and therefore, was allowed to discontinue lead sampling in March 1997.

### 4.7.2.5 Summary

There have been no violations of the NAAQS for the six criteria pollutants in the Tucson Air Planning Area for the past 10 years. Tucson is the largest city in the country in attainment for all criteria pollutants. For CO, the Tucson Air Planning Area is currently in attainment under the CO Limited Maintenance Plan, and there is a low likelihood of violating the national standard in the future. Despite exceedences and violation in 1999 of $PM_{10}$ levels, the Tucson Air Planning Area is still in attainment. The exceedances were flagged as natural events, and a Natural Events Action Plan is currently being developed. The Tucson Air Planning Area is currently in attainment for $O_3$. While ozone concentrations are relatively steady, the levels are slowly approaching the NAAQS, and there is a moderate likelihood of violating the NAAQS. Currently, the region is in attainment for $NO_2$ and $SO_2$ and there is a low likelihood of violating the NAAQS in the future.

The Rillito Air Planning Area continues to be in non-attainment for $PM_{10}$. The EL Rio Antiguo study area lies entirely within the Tucson Air Planning Area, and the Rillito Air Planning Area is located at least 15 miles to the northwest. Given the distance between the study site and the Rillito Air Planning Area, the $PM_{10}$ non-attainment status is not expected to have substantial impact on the feasibility study for El Rio Antguo, although the non-attainment status for $PM_{10}$ will certainly be taken into consideration.

# 4.7.3 Regulatory Setting

Federal, state, and regional agencies have established standards and regulations addressing air pollutant emissions that may be pertinent to the study area.

## 4.7.3.1 Federal and State Regulations

- The federal Clean Air Act of 1970 directs the attainment and maintenance of NAAQS for six "criteria" pollutants (e.g., ozone, carbon monoxide).

- The 1977 Clean Air Act enacted legislation to control seven air toxic pollutants. EPA adopted the National Emissions Standards fro Hazardous Air Pollutants (NESHAP), which were designed to control Hazardous Air Pollutants (HAP) emissions to prevent adverse health effects in humans.

- The 1990 Amendments to this Act determine attainment and maintenance of NAAQS (Title I), motor vehicles and reformulation (Title II), hazardous air pollutant (Title III), acid deposition (Title IV), operating permits (Titles V), stratospheric ozone protection (Title VI), and enforcement (Title VII).

- The EPA implements the New Source Review (NSR) and Prevention of Significant Deterioration (PSD) regulations.

- Arizona's State Implementation Plan

- EPA's Natural Events Policy

- ADEQ's Air Quality Exceptional and Natural Event Policy

## 4.7.3.2 Regional and Local Regulations

- ADEQ has the primary authority in the state of Arizona for air pollution control and abatement including maintaining a SIP and adopting rules that assure compliance with and attainment of the NAAQS.

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- PDEQ is the local air pollution control agency and has jurisdiction over air pollution sources that are not under state jurisdiction. PDEQ is responsible for monitoring the ambient air quality of the region by collecting and analyzing air quality data.

- PAG is the lead air planning organization for Pima County and addresses regional air quality issues in keeping with federal, state, and local requirements. It is responsible for determining which elements of the state implementation plan will be planned, implemented, and enforced by state and local governments. PAG is responsible for the development of air pollution reduction and maintenance area plans, for implementing the PAG Travel Reduction and RideShare Programs, and for making transportation/air quality conformity determinations.

- 1996 Carbon Monoxide Limited Maintenance Plan for the Tucson Air Planning Area (updated August 1997).

- Pima County Natural Events Action Plan developed by PDEQ in cooperation with ADEQ.

- Arizona Vehicle Emissions Inspection Program (VEIP) identifies vehicles that do not meet state emission standards. This program acts as a tool to maintain federal tailpipe emissions controls and subsequent benefits through vehicle inspection and repair.

- Arizona Oxyfuels Program was implemented in 1990 in order to reduce CO levels. By requiring oxygenated fuel from October until March, vehicle emissions are reduced.

- PAG Travel Reduction Program (TRP) encourages alternate modes of transportation such as taking the bus, bicycling, and walking, in order to reduce traffic congestion and reduce vehicle emissions. This program also promotes alternative fuel vehicles, modified work schedules, and telecommuting. Employers with 100 or more employees at a single site are required to participate in this program.

- Pima County Voluntary No-Drive Days (Clean Air) Program; this state-mandated program promotes strategies, such as K-12 classroom presentations, teacher trainings, speakers bureau, smoking vehicle hotline, and public education at community outreaches to encourage the public to take actions to reduce air pollution.

- Pima County Voluntary Vehicle Repair and Retrofit Program (V2R2) is a program that provides financial assistance to repair older vehicles that fail the

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emissions test. Tests show that this type of repairs typically reduces emissions by approximately 80 percent.

- Pima County Voluntary Lawn and Garden Equipment Collection Program is targeted at high-polluting gas-powered two- and four-stroke motors in lawn mowers, and other gas-powered gardening equipment such as leaf blowers, string trimmers, and chain saws. This program provides vouchers for the purchase of electric or manual equipment to people who voluntarily drop off their gas-powered equipment.

- Mass Transit is provided by Sun Tran. Service is primarily within Tucson; however, it also extends into the county, South Tucson, and Oro Valley. Sun Tran is converting part of its bus fleet to compressed natural gas fuel.

- Rideshare Program promotes carpooling and other alternate modes of travel to improve air quality, save energy, and decrease traffic congestion. This program maintains several databases including a carpooling database, an out-of-county carpooling database, and a parent pool database for parents transporting children to and from school. Rideshare also produces an annual Bike Map and provides information on telecommuting.

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## 4.7.4 References

Arizona Meteorological Network (AZMET)
Arizona Meteorological Network website. www.ag.Arizona.edu/azmet.

Pima County
2001 Air Quality in Pima County. February.

Pima County Department of Environmental Quality
2000 Air Quality Summary Report (AQ-332) and Appendix (AQ-333).

2002 Personnel communication with Deborah Jentoft.

# 4.8 Noise

This section describes the existing noise environment in the region of the study area, including noise-producing activities and the regulatory requirements associated with the maintenance of acceptable noise levels.

## 4.8.1 Existing Noise Environment

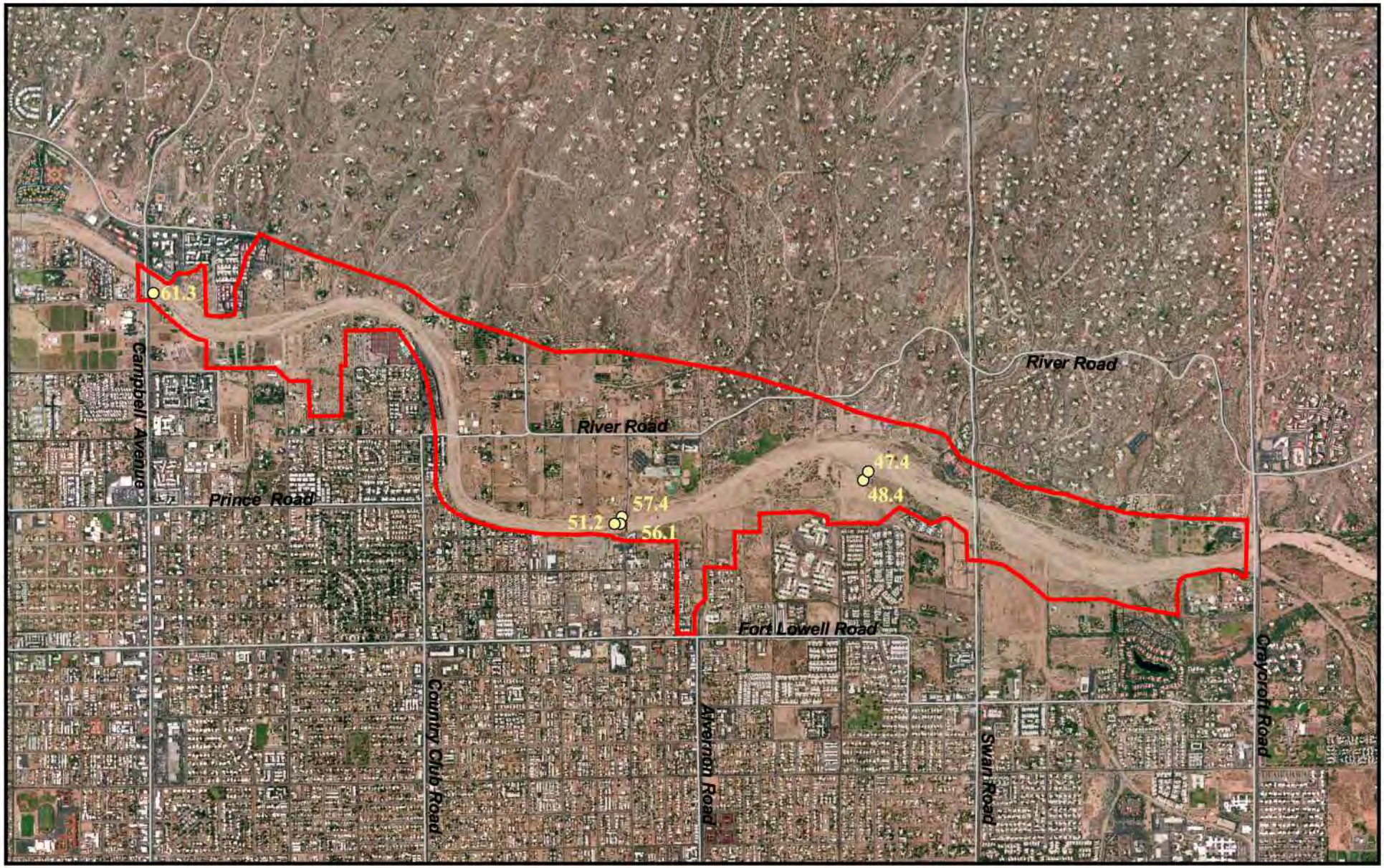
### 4.8.1.1 Transportation Noise Sources

Noise levels in the project study area are primarily influenced by traffic on the local roadways. These noise levels range from relatively low to moderate levels along the river away from the roadways to high noise levels immediately adjacent to the roadways. Variation in exposure to noise levels depends primarily on proximity to roadway traffic and to other noise generating uses.

The primary noise generating roadways in the study area are those discussed in Section 4.13 Transportation. Roadways crossing the Rillito River include, from west to east, Campbell Avenue, Dodge Boulevard, Swan Road, and Craycroft Road. Figure 4.8-1 shows an aerial photograph of the study area, along with noise measurements. The north-south crossings are all bridged, with vehicles elevated above the riverbed. Noise levels immediately adjacent to these crossings are relatively high, typically between 65 and 75 A-weighted decibels [dBA] within 100 feet. As distance from these roadway crossings increases, traffic noise levels drop significantly. For example, the noise measurement taken by Campbell Avenue is 61.3 dBA $L_{eq}$, which reflects the noisy character of the heavily traveled Campbell Avenue roadway. As one travels along the riverbed, or riverbank trails, away from the bridge at Campbell Avenue, noise levels dramatically decrease. To the west of Campbell Avenue, away from the roadway noise, one can actually hear the occasional "moo" from a cow, and to the east of Campbell Avenue it is similarly quiet near the University of Arizona Agricultural Research Center.

Recent existing traffic volumes on the major roads in the study area range from a low of approximately 16,300 average daily trips (ADT) on Dodge Boulevard to a high of approximately 34,100 ADT on Campbell Avenue. Corresponding daytime average hourly traffic noise levels at 50 feet from the roadway are projected to range from approximately 69 dBA $L_{eq}$ (average noise level) adjacent to Dodge Boulevard to over 72 dB(A) $L_{eq}$ adjacent to Campbell Avenue.

A series of six noise measurements were made adjacent to the Rillito River by RECON on Friday, March 1, 2002, between the hours of 10:45 A.M. and 1:15 P.M. The weather was warm and sunny with a slight breeze. Six 15-minute measurements were taken




RECON

Image Source: 2001 AirPhotoUSA (flown October 1999)

0 Mile .5

Study area

Noise Measurement Location

47.4 Measured Noise Level dB(A)

# FIGURE 4.8-1

**Noise Measurement Locations and Measured Noise Levels**

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adjacent to the Rillito River within the project study area as shown in Figure 4.8-1. These locations were chosen to obtain existing noise levels adjacent to the Rillito River in order to characterize the existing ambient noise condition. As seen in Figure 4.8-1, the measured noise levels range from approximately 47 to 61 dBA $L_{eq.}$

It is noted that motorized vehicles are prohibited both within the riverbed and from the riverpark trails, which are located along the top of the riverbanks. The exceptions to this are the small, all-terrain vehicles used by Pima County staff to patrol the riverbed and riverpark. These vehicles produce low levels of noise, infrequently, for short periods of time.

Overhead flights of military, commercial, and private aircraft contribute to the ambient noise environment. However, no airports or landing strips are located within 10 or more miles of the study area. No flights are allowed below 1,000 feet above ground surface in this area. (See further discussion under Regulatory Setting). Consequently, aircraft operations associated with the airfields in the vicinity generally are at sufficient altitude so as to not generate substantial noise levels in the study area.

Trains do not make a significant contribution to the noise environment. The closest railway is approximately six miles west of Campbell Avenue. Associated noise of warning horns is barely audible at most.

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### 4.8.1.2 Stationary Noise Sources

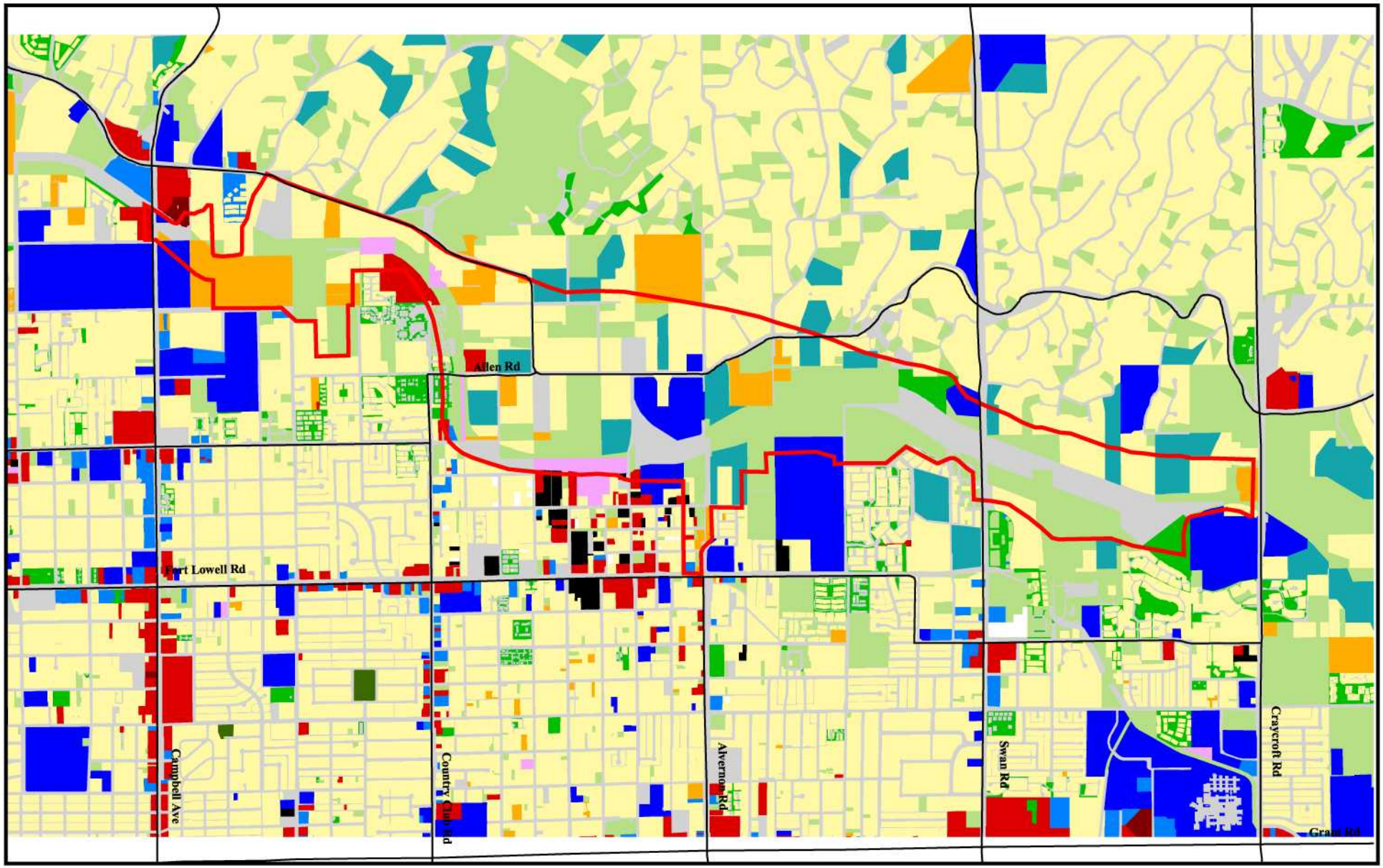
Secondary noise sources of occasional noise in the study area include the ballfields, tennis courts, and other similar facilities for sports and recreational activities. Noise levels associated with these types of uses are generally not substantial.

Other noises in the study area are typical of more rural, agricultural uses, particularly on the northern side of the study area west of Dodge Boulevard.

## 4.8.2 Sensitive Noise Receptors

Land uses and activities that are considered to be sensitive to noise include residential properties, recreation areas, churches, and schools.

As seen in Figure 4.8-2, land uses within and around the study area are primarily residential (predominantly low to medium density, with some areas of high density also occurring), or vacant with some commercial in limited areas. Other land uses in the study area include agricultural, recreational, schools, open space, religious facilities, and a nursing care facility.

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Study area

0 Mile .5

Land Use Categories

- Industrial
- Commercial
- Lodging
- Agricultural
- Residential
- Government
- Utility
- Office
- Institutional
- Open Space
- Park
- Rural
- Vacant
- Other

# FIGURE 4.8-2

**Land Use Designations In and Around the Study Area**

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Although not areas of permanent occupancy, the recreational pathways along the river and the riverbed itself are areas where a quiet environment is probably desirable. Visitors to these areas would likely enjoy a low noise level environment.

Additionally, wildlife species, such as birds associated with the remnant riparian areas, may have particular sensitivity to noise levels particularly during periods when they are vocally establishing territories. However, this effect is not well established.

# 4.8.3 Regulatory Setting

Federal, state, and regional agencies have established standards and regulations addressing noise levels that may be pertinent to the study area.

## 4.8.3.1 Federal and State Regulations

- Under the National Environmental Policy Act (NEPA), impacts and measures to mitigate adverse impacts must be identified, including the identification of impacts for which no or only partial mitigation is possible.

- For federal or federally supported highway project, the Federal Highway Administration (FHWA) regulations as codified in 23 CFR 772 constitute the federal noise standard. Projects complying with this standard are also in compliance with the requirements stemming from NEPA.

  Under FHWA regulations, noise abatement must be considered for Type I projects (as defined in 23 CFR 772) when the project results in a *substantial noise increase* (12 dBA, $L_{eq}(h)$), or when the predicted noise levels *approach or exceed* the Noise Abatement Criteria (NAC). Noise abatement measures which are *reasonable* and *feasible* and that are likely to be incorporated in the project, as well as noise impacts for which no apparent solution is available, must be identified and incorporated into the project's plans and specifications (23 CFR 772.11(e)(1) and (2)). The NAC are defined in Table 4.8.1 (23 CFR 772).

- The Department of Housing and Urban Development (HUD) has established exterior noise goals for siting HUD supported housing projects. The HUD goals, as specified in 24 CFR 51, Subpart B, establishes a basic goal for residential exterior noise levels at 55 dBA day-night average sound level ($L_{dn}$).

- Under the EPA, the Occupational Safety and Health Administration (OSHA) regulates occupational noise exposure in the workplace. These regulations are codified in 29 CFR 1920.95 and are addressed and implemented through a construction contractor's or facility's health and safety plan.

draft

**TABLE 4.8-1**
**NOISE ABATEMENT CRITERIA (NAC)**
**[Hourly A-Weighted Sound Level – decibels (dBA)[1]]**

| Activity Category | $L_{eq}(h)$ | $L_{10}(h)$ | Description of Activities |
|---|---|---|---|
| A | 57 (exterior) | 60 (exterior) | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. |
| B | 67 (exterior) | 70 (exterior) | Picnic areas, recreation areas, playgrounds, active sport areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals. |
| C | 72 (exterior) | 75 (exterior) | Developed lands, properties, or activities not included in Categories A or B above. |
| D | - | - | Undeveloped lands. |
| E | 52 (interior) | 55 (interior) | Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums. |

SOURCE: 23 CFR 772.

[1]Either $L_{eq}(h)$ or $L_{10}(h)$ (but not both) may be used on a project.

- The Arizona Department of Transportation (ADOT) utilizes the FHWA standards for all ADOT funded roadway projects.

## 4.8.3.2 Regional and Local Regulations

### a. Pima County

- The Pima County Comprehensive Plan does not specify specific land use compatibility standards for siting sensitive uses adjacent to transportation noise sources. Additionally, construction noise is not regulated by ordinance.

- For roadway projects, Pima County specifies the following requirements through Ordinance Number 1992-69, Section 7.1(c) "Noise Abatement":

  Noise abatement shall be incorporated into the project design to protect inhabited residential or other sensitive land uses from roadway traffic noise. Noise abatement measures shall be considered for these land uses when existing or design year projections of exterior traffic noise measurements exceed an hourly A-weighted sound level of 67 dBA. The preferred method of noise abatement shall be the construction of noise barrier walls. Other methods may be utilized if the cost to Pima County does not exceed the cost of noise barrier walls.

- Pima County has several regulations pertaining to the transmission of noise between a generating land use and a receiving land use. Chapter 9.30 of the Pima County Zoning Code, "Regulation of Excessive, Unnecessary and Annoying Noises" prohibits noise that disturbs the peace or quiet of neighborhoods. Between 10 P.M. and 7 A.M. music or other noise must be kept quiet enough such that it is not heard beyond the property line of its source. Other specifics of the ordinance restrict construction noise and faulty vehicle mufflers. Emergency vehicles are exempt.

  Other noise performance standards are codified in Chapters 18.43 (CB-1 Local Business Zone), 18.49 (CPI Campus Park Industrial Zone), and 18.53 (CI-2 General Industrial Zone). Again, these performance standards pertain primarily to the transmission of noise between a generating land use and a receiving land use.

- Chapter 18.57 of the Pima County Zoning Code, "Airport Environ Zones" establishes structure height and land use overlay zones in areas adjacent to local airports. These zones do not extend into any portion of the El Rio Antiguo study area. Private airports are permitted in zones that do not occur within the study area (i.e., RH, IR, and Industrial).

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- Chapter 18.58 of the Pima County Zoning Code, "Heliports and Helistops" establishes standards to protect noise-sensitive land uses from disturbing levels of helicopter noise. Permitted zones include CI-1, CI-2, and CI-3, none of which occur in the El Rio Antiguo study area. Permitted locations include private airports and hospitals, neither of which occur within the study area.

## b. City of Tucson

- The City of Tucson General Plan does not specify specific land use compatibility standards for siting sensitive uses adjacent to transportation noise sources. Additionally, construction noise is not regulated by ordinance.

- The City of Tucson has several regulations pertaining to the transmission of noise between a generating land use and a receiving land use. For example, the City of Tucson's Code Section 11-84 prohibits the operation of excessively loud sound amplification systems in vehicles. Emergency vehicles are exempt, as are other authorized circumstances. The City of Tucson's Code Section 11-140 prohibits loud or unruly gatherings, classifying them as public nuisances.

- City of Tucson ordinances do not apply to the University of Arizona facilities.

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# 4.9 Cultural Resources

## 4.9.1 Environmental Setting

### 4.9.1.1 Cultural Background

The Tucson Basin has been witness to human activity for over 10,000 years as evidenced by the observation of a few artifacts of this age on the surface as shown in Table 4.9-1. The chronological period involving the nomadic explorations by early man is referred to as the Paleoindian Period. The Archaic Period that follows is characterized by the exploitation of a greater diversity plant and animal species than in the preceding Paleoindian Period. A more diverse subsistence base lessened the need for a nomadic lifestyle (O'Mack and Klucas 2002:28). The Archaic is divided into Early, Middle and Late periods. Very little evidence exists for Early Archaic occupation of the Tucson Basin. More recently during the Middle Archaic Period, villages along the Santa Cruz River developed approximately 5,000 years ago. Indigenous groups collected wild plants, hunted small animals, and cultivated maize. Pottery was introduced to the Tucson Basin approximately 2,000 years ago during the Late Archaic Period. The use of pottery is associated with sedentary, agricultural societies. Settlements (round houses) became larger and there was an increasing dependence on agriculture. There is also an increased focus on storage of foods.

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As large scale irrigation agriculture developed in the succeeding Formative Period, the pace and complexity of culture change increased dramatically. The Formative Period is subdivided into Early, Pioneer, Colonial, Sedentary, and Classic Periods. Early Period subsistence was a mix of hunting agriculture and hunting and gathering. Painted ceramics were introduced approximately 1400 years ago. The succeeding Pioneer Period witnessed the construction of ball courts at large primary villages (O'Mack and Klucas 2002:31). The Hohokam culture developed in the Phoenix area around 1300 years ago, spreading to the Tucson Basin during this same period. Decorated pottery, ball courts, and floodplain canal systems are all characteristics of the Hohokam culture. In the following Colonial Period there was emphasis on large primary villages with an increase of the use of floodplain environments. The prehistoric population of the Tucson Basin was at its highest levels approximately 1,000 years ago during what is called the Sedentary Period. There appears to be major settlement shift, however, where several large primary villages were abandoned. According to some researchers, the Hohokam on a regional level collapsed at the end of this period (Ciolek-Torrello 1999:35). Additionally, the succeeding Classic Period was the time when semi-subterranean, rectangular rooms were favored, platform mounds over ball courts, and burial practices shifted from cremation to inhumation. These changes can be attributed to either the arrival of the Salado culture during this time period or in situ cultural evolution.

By the time the explorer Father Kino traveled to the Tucson Basin in 1694, the Hohokam culture had continued to evolve. Some say the Hohokam disappeared from the area.

**TABLE 4.9-1**
**CHRONOLOGICAL CULTURAL OVERVIEW OF THE TUCSON BASIN**

| Time | Stage | Period | Tucson Basin Phases |
|---|---|---|---|
| A.D. 1900 | | Historic | Euroamerican |
| A.D. 1800 | | | Mexican |
| A.D. 1600 | | | Spanish |
| A.D. 1500 | | Protohistoric | Piman |
| A.D. 1400 | | Classic | Tucson |
| A.D. 1300 | | | Tanque Verde |
| A.D. 1200 | (Hohokam) | Sedentary | Late Rincon |
| A.D. 1100 | | | Middle Rincon |
| A.D. 1000 | | | Early Rincon |
| A.D. 900 | | Colonial | Rillito |
| A.D. 800 | Formative | | Canada del Oro |
| A.D. 700 | | | Snaketown |
| A.D. 600 | | | Early Broadline |
| A.D. 500 | | Pioneer/Early Formative | Tortolita |
| A.D. 400 | | | |
| A.D. 300 | | | Agua Caliente |
| A.D. 100 | | | |
| 100 B.C. | Archaic | Late Archaic | Cienega |
| 500 B.C. | | | San Pedro |
| 1000 B.C. | | | |
| 2000 B.C. | | Middle Archaic | Chiricahua |
| 6000 B.C. | | | |
| 9000 B.C. | | Early Archaic | Sulphur Springs-Ventana |
| | Paleoindian | | |

Environmental stress brought on by a series of droughts and floods may have had catastrophic effects on irrigation-based societies such as the Hohokam. That does not address the fact, however, that the Tucson Basin was never abandoned. The Spanish encountered several villages in the Tucson basin, the largest at Bac (later San Xavier del Bac). The Spanish called the native inhabitants of Tucson the Sobaipuri. The word is a Hispanicized native term and its meaning is unclear. The Sobaipuri have since ceased to exist as a distinct cultural group.

As European exploration continued, San Xavier Mission south of Tucson was founded in 1700, originally as a visita. A Spanish presidio was established in 1776 in what is currently downtown Tucson to provide protection to a growing number of Spanish settlers. The Gadsden Purchase of 1853 placed the geographic area encompassing Arizona under United States possession, settling a long dispute with Mexico. Arizona was declared a territory separate from New Mexico in 1863. Fort Lowell was founded in 1873 on the south side of the Rillito River near the confluence of Pantano Wash and Tanque Verde Creek. The Arizona Territory was admitted as the 48th state in the union in 1912. According to historic maps, the project area was sparsely developed until recent times.

The Tucson Basin today is the home of the Tohono O'odham Nation and the Pascua Yaqui Tribe. Tohono O'odham means desert or country people. Their language is called Piman and is part of the Uto-Aztecan language family. The name Pima has been in the Spanish literature since the seventeenth century and may be a Spanish variant of the Native American word pimahaitu meaning 'nothing' (Fontana 1983:134). In addition to the term Sobaipuri, the Spanish called the Tohono O'odham and native peoples of the Tucson Basin papago. Papago is a Hispanicized Native American term meaning 'bean eater.' This term has lost favor in recent times and more traditional terms are now employed. There is continuing debate on whether or not there is genetic and cultural connection between the prehistoric Hohokam and the Tohono O'odham. The Pascua Yaqui are also part of the Uto-Aztecan language family and emigrated from Mexico to the Tucson area approximately 100 years ago.

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### 4.9.1.2 Chronology

The Chronology below is adapted from Ciolek-Torrello et al. (1999), Dean (1991), Deaver and Ciolek-Torrello (1995), Mabry et al. (1997), and Wallace and Craig (1988).

### 4.9.1.3 Existing Conditions

Statistical Research, Inc. (O'Mack et al. 2002) through the Arizona State Museum (ASM) performed a literature search and cultural resources overview of the proposed project area (area of potential effects [APE]). This search indicates that over 50 percent of the APE has been surveyed by archeologists. These surveys have recorded 14 archeological sites within the project APE. At least three sites are eligible for the National Register including AZ

BB:9:18, AZ BB:9:238 (historic Mormon settlement of Binghampton), and AZ BB:9:302 (Davidson Flume).

Given the project's association with the Rillito River floodplain, the overall archeological sensitivity and potential is very high. Therefore, complete avoidance therefore of all cultural resources by project alternatives may be unsuccessful.

### 4.9.1.4 Environmental Commitments

If necessary, a survey of previously unsurveyed areas within the project's area of potential effects will be performed by qualified archeologists. Subsurface exploration to determine the presence/absence of buried cultural deposits may also be necessary. If National Register listed or eligible properties will be adversely affected by the project, a Memorandum of Agreement will be negotiated with the Arizona State Historic Preservation Officer (SHPO) and interested Native American Tribes. An archeological site treatment plan will be developed in consultation with the SHPO and interested Native American Indian tribes.

### 4.9.1.5 National Historic Preservation Act of 1966 (36 CFR 800)

In accordance with 36 CFR 800, regulations implementing Section 106 of the National Historic Preservation Act, a records search has been performed. The Corps' determinations of eligibility and effect will be coordinated with the Arizona SHPO. If National Register listed or eligible properties will be adversely affected by the project, a Memorandum of Agreement (MOA) will be negotiated with the Arizona SHPO and interested Native American tribes. An archeological site (historic properties) treatment plan will be developed in consultation with the SHPO and interested Native American Indian tribes as stipulated in the MOA. Currently, the project is not in compliance with the Act.

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## 4.9.2 Regulatory Setting

The federal government has developed laws and regulations designed to protect cultural resources that may be affected by actions undertaken, regulated, or funded by federal agencies. The National Historic Preservation Act (NHPA) of 1966 established the Advisory Council on Historic Preservation (ACHP) and SHPO to assist federal and state officials regarding matters related to historic preservation. Section 106 of the act requires federal agencies to consider the effects of an action on cultural resources in or eligible for listing in the National Register of Historic Places (NRHP). The administering agency, the ACHP, has authored regulations implementing Section 106 located in 36 CFR Part 800, Protection of Historic Properties (recently revised, effective June 17, 1999).

The proposed action is considered an undertaking, and therefore must comply with the NHPA. The NHPA provides detailed procedures called the Section 106 process by which

the assessment of impacts on archaeological and historical resources, as required by the Act, is implemented.

According to NHPA, three steps are required for compliance: (1) identification of significant resources that may be affected by an undertaking; (2) assessment of project impacts on those resources; and (3) development and implementation of mitigation measures to offset or eliminate adverse impacts.

### 4.9.2.1 Identification and National Register Historic Places Evaluation

Regulation 36 CFR Part 800.3 discusses the consultation process. Section 800.4 sets out the steps the Agency must follow to identify historic properties. Regulation 36 CFR 800.4(c)(1) sets out the process for NRHP eligibility determinations.

The Historic Sites, Buildings, and Antiquities Act of 1935 established the NRHP and assigned the responsibility for carrying out this policy to the U.S. Department of the Interior, National Park Service (NPS). Per NPS regulations 36 CFR 60.4 and guidance published by the NPS, "National Register Bulletin, Number 15, How to Apply the National Register Criteria for Evaluation," different types of values embodied in districts, sites, buildings, structures, and objects are recognized. These values fall into the following categories:

- Associate Value (Criteria a and b): Properties significant for their association or linkage to events (Criterion a) or persons (Criterion b) important in the past.

- Design or Construction Value (Criterion c): Properties significant as representatives of the manmade expression of culture or technology.

- Information Value (Criterion d): Properties significant for their ability to yield important information about prehistory or history.

Cultural resources that are determined eligible for listing in the NRHP, along with State Historic Preservation Officer concurrence, are termed "historic properties" under Section 106, and are afforded the same protection as sites listed in the NRHP.

### 4.9.2.2 Results of Identification and Evaluation

Results of literature searches, field surveys, and tribal consultation are coordinated with the SHPO staff. Regulation 36 CFR Part 800.4(d) stipulates that when an agency finds that either there are no historic properties present or there are historic properties present but the undertaking will have no effect upon them, then the agency will make a "no historic properties affected" determination. If the agency finds that there are historic properties that may be affected by the undertaking, the agency will make a "historic properties affected" determination.

### 4.9.2.3 Assessment of Adverse Effects

In accordance with 36 CFR Part 800.5 of the ACHP's implementing regulations, criteria of adverse effect, impacts on cultural resources are considered significant if one or more of the following conditions would result from implementation of the proposed action:

(a) An undertaking has an effect on a historic property when the undertaking may alter characteristics of the property that may qualify the property for inclusion in the NRHP. For the purpose of determining the type of effect, alteration to features of a property's location, setting, or use may be relevant depending on a property's significant characteristics and should be considered.

(b) An undertaking is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects on historic properties include, but are not limited to:

(1) Physical destruction, damage, or alteration of all or part of the property.

(2) Isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the NRHP.

(3) Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.

(4) Neglect of a property resulting in its deterioration or destruction.

(5) Transfer, lease, or sale of the property.

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### 4.9.2.4 Resolution of Adverse Effects

Regulation 36 CFR Part 800.6 details provisions relating to Memoranda of Agreement. The negotiation of such a document evidences an agency's compliance with Section 106 of the NHPA and is obligated to follow its terms. An agreement document is prepared in consultation with the SHPO. The ACHP is notified regarding the project and may participate. Interested Native American tribes and other parties are provided the draft materials and are invited to be concurring or consulting parties to the agreement document. Mitigation measures defined in an agreement document may include data recovery excavations involving prehistoric sites, or photographic documentation and archival research for historic resources (standing buildings and structures).

### 4.9.2.5 Coordination

Arizona State Historic Preservation Officer (SHPO) – A letter will be sent to the SHPO with our determination of eligibility and effect in accordance with 36 CFR 800.4(d). All supporting documentation required under 36 CFR 800.11(d) will be sent to the SHPO. This includes the draft EIS.

The draft EIS will also be sent to the following for comment:

Pima County - Ms. Linda Mayro, County Archeologist
Tohono O'odham Nation – Mr. Peter Steere
Hopi Tribe – Mr. Leigh Kuwanwisiwma

## 4.9.3 References

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# 4.10 Hazardous and Toxic Waste

## 4.10.1 Introduction

This section discusses occurrences and sources of potential hazardous, toxic, and radioactive waste (HTRW) in and around the El Rio Antiguo study area. Additional information and details regarding HTRW can be found in Appendix G, the HTRW Framework Research report.

The report in Appendix G includes details such as methodology, potential source areas, contaminant release mechanisms, exposure routes, potentially exposed populations, as well as potential adverse health effects and potential receptors. This assessment, summarizing HTRW occurrences in the vicinity of the project area, identifies potential Recognized Environmental Conditions (RECs) associated with individual properties. It is important to note that no exploratory borings, soil or groundwater sampling, or laboratory analyses were performed at the property as part of the report in Appendix G.

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## 4.10.2 Environmental Setting

### 4.10.2.1 Hydrogeology

Hydrogeology of the study area and vicinity is briefly discussed as it relates to groundwater flow and potential contamination by HTRW. Details and additional information can be found in Section 4.2, Hydrology and Water Resources, as well as Appendixes B, C, and D. The regional aquifer consists of alluvium that is divided by Upper, Middle, and Lower Basin Fill hydrostratigraphic units. In general, sediments of the Lower Basin Fill are less transmissive than sediments of the Upper Basin Fill, but the Lower Basin Fill stores a greater volume of water than the Upper Basin Fill because of its greater thickness (Hanson and Benedict 1994). Groundwater flow within the Tucson Basin is generally to the north-northwest. The aquifer is generally unconfined to depths of 1,500 feet. Movement and storage of groundwater depends on transmissive and storage properties of the aquifer, along with hydraulic properties including lithologic factors such as grain size, sorting, and cementation (Hanson and Benedict 1994).

Inflows to the Tucson regional aquifer occur as groundwater underflow from the northeast, south and southeast, mountain-front recharge, and natural infiltration along stream channels. Outflows from the Tucson Basin occur as well pumpage, evapotranspiration, and groundwater underflow to the northwest. Inflows are estimated to be approximately 100,000 acre-feet, and stream channel infiltration approximately 51,000 acre-feet (Davidson 1973). However, since the 1940s, groundwater withdrawals

have exceeded natural recharge and underflow into the basin. As a result, significant groundwater level declines have been observed within the basin.

In the El Rio Antiguo study area depth to the regional groundwater is approximately 50 to 100 feet below ground surface (bgs) and the general direction of regional groundwater flow is to the southwest beneath the study area. In the vicinity of the Columbus Landfill, groundwater flow is generally toward the south to southwest with depths to water near the landfill between 10 to 40 feet bgs near the river, and 116 feet bgs approximately one-half mile south of the landfill (PAG 2000). Variability of local groundwater levels may be in response to mounding of groundwater from recharge in the Rillito River and localized pumping conditions.

### 4.10.2.2 Hazardous, Toxic, and Radioactive Waste

Existing and past land use was evaluated, based on a review of the historical records and other public documentation, to evaluate the potential presence of HTRW sites in and around the study area. Prior to 1946, the study area was used for agricultural and residential purposes. In the late 1940s and early 1950s, development in the area was prominent as the city of Tucson started expanding to the north. The area along Kleindale Road has developed as a light industrial and commercial area during this time. Historically, properties north of the Rillito River supported small privately owned ranch and livestock operations. Currently, the area is more residential with a distinct rural characteristic. The University of Arizona agricultural and research facilities have developed in the southwest corner of the study area, south of the Rillito River. Much of the study area has and continues to be used for residential purposes.

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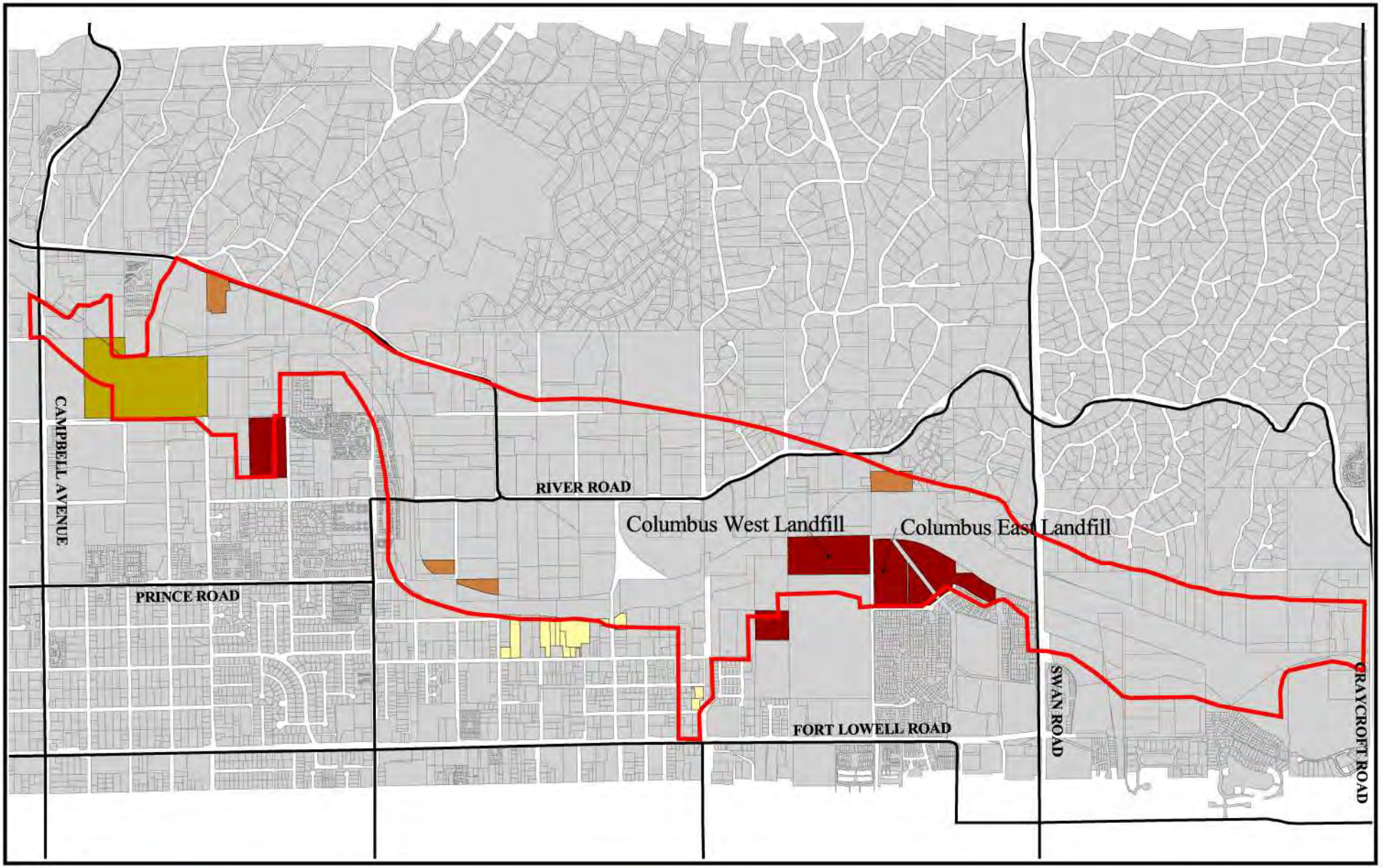
Currently, much like the study area, the surrounding land use is predominantly residential interspersed with some commercial, manufacturing, and light industrial properties. Pima County (Department of Transportation and Flood Control) owns most of the land within the Rillito River and Alamo Wash channels. Land outside of the channels is primarily privately owned, with the exception of several public parks.

Four areas within the El Rio Antiguo study area have significant HTRW findings and further investigation should be required. These areas include properties within the Kleindale Road industrial area, the University of Arizona Campus Agricultural Center, selected commercial and private properties located along the north bank of the Rillito River, and closed solid waste landfills and "wildcat dumps." These areas are shown in Figure 4.10-1. Potential contaminants of concern at these sites include solvents, petroleum hydrocarbons, polychlorinated biphenyls (PCBs), pesticides, metals, and asbestos. The four closed solid waste landfills, the Columbus 1 and 2 Landfills, the Walnut Landfill, and the Cactus Landfill, are also shown in Figure 4.10-1. These landfills began as sand and gravel operations, and then were active and operated by the City of Tucson from approximately 1960 to 1980. Hydrology studies indicate that groundwater

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Study Area

Major Streets

Parcel boundaries

0 Mile .4

Kleindale Industrial District

Selected Properties North of Rillito Creek

Area Landfills/Wildcat Dumping

University of Arizona Agricultural and Research LAboratories

# FIGURE 4.10-1

**Areas with Hazardous, Toxic, and Radioactive (HTRW) Findings**

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contamination has not been found close to, or downgradient of the Columbus Landfill (PAG 2000).

### 4.10.2.3 Previous Investigations

The Rillito River has been studied by several government agencies for the feasibility of recharge to groundwater by direct impoundment (PCDOT and FCD 1996). Results of these studies have indicated that impoundment of surface water in the Rillito River channel would enhance the natural infiltration of runoff water in an area where the demand for groundwater is high, which is very beneficial. As part of these studies, local hydrologic and hydrogeologic conditions have been identified. More important to HTRW concerns, these studies included investigations of landfills within the study area to determine the potential for groundwater impacts.

Three abandoned landfills, Walnut, Columbus 1, and Columbus 2, located along the Rillito River between Swan Road and Dodge Boulevard were operated by the City of Tucson intermittently from the 1960s through 1980s (PAG 1989). The fourth landfill, Cactus, is thought to be in or adjacent to the study area.

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At the Walnut Landfill, studies indicate that there is little potential for future groundwater contamination. No volatile organic compounds (VOCs) detected in soil had concentrations above background levels (Camp Dresser McKee 1990), however, high levels of methane gas have been detected in the vicinity of the landfill, so potential future impacts from methane are possible. Additional studies are needed to determine this (AJAY Environmental Consultants 1993).

Groundwater studies at the Columbus Landfills indicate that there is no evidence of groundwater contamination. This is based on groundwater samples collected directly downgradient from the Landfill. However, the wells sampled are more than one-half mile from the Columbus Landfill areas, and pumped groundwater from depths greater than 100 feet. Therefore, these samples did not include the shallower aquifers in the vicinity of the landfill where potential contamination is likely to occur (PAG 2000).

While there is little evidence of local groundwater contamination from the Columbus and Walnut landfills, additional monitoring wells and further sampling are needed to establish groundwater conditions and the potential for future groundwater contamination from the closed landfills. In addition, further soil gas monitoring is needed to evaluate the long-term impact of methane at the Walnut Landfill.

### 4.10.2.4 Summary

Several areas and specific properties within or adjacent the Rio Antiguo study area have documented HTRW release or potential releases as indicated by current or historic site

conditions. Sites with significant findings are summarized in Table 4.10-1. These areas include closed solid waste landfills and wildcat dumps, properties within an area described as the Kleindale Industrial district, the University of Arizona Campus Agricultural Center, and selected commercial and private properties located along the north bank of Rillito Creek. Potential contaminants of concern identified during the HTRW Framework Research investigation included solvents, petroleum hydrocarbons, PCBs, pesticides, metals, and asbestos. These properties were determined to have potential for HTRW based on visual or historical evidence of HTRW storage or disposal, listing in the regulatory environmental databases with one or more recorded releases of hazardous materials, or current or historical operations known to be associated with use, storage, or disposal of HTRW.

# 4.10.3 Regulatory Setting

The following section discusses some of the regulations pertaining to HTRW.

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## 4.10.3.1 Federal

The principal federal regulatory agency for hazardous wastes is the U.S. Environmental Protection Agency. The two key federal regulations pertaining to hazardous wastes are described below. Other applicable federal regulations are contained primarily in Titles 29 (Labor), 40 (Protection of Environmental), and 49 (Transportation) of the Code of Federal Regulations.

## 4.10.3.2 Resource Conservation and Recovery Act (RCRA)

This act directs the EPA to administer a regulatory program that extends from manufacture of hazardous materials to their disposal. The law regulates the generation, transportation, treatment, storage, and disposal of hazardous waste at all facilities and sites in the nation. The RCRA was amended in 1984 by the Hazardous and Solid Waste Act, which affirmed and extended the "cradle to grave" system of regulating hazardous wastes.

## 4.10.3.3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

This act, also known as Superfund, was passed to facilitate the cleanup of the nation's toxic waste sites. In 1986, Superfund was amended by the Superfund Amendment and Reauthorization Act (SARA), Title III (community right-to-know laws). Title III states that past and present owners of land contaminated with hazardous substances can be held liable for the entire cost of the cleanup, even if the material was dumped illegally when the property was under different ownership.

**TABLE 4.10-1**
**SUMMARY OF HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) SITES**

| Potential HTRW Site | Location | Description |
|---|---|---|
| Columbus Landfill 1 and 2 | South bank of Rillito River, north of Columbus Blvd. | May have low potential to impact groundwater. More information needed regarding landfill boundaries, waste depth, and gas and water monitoring. |
| Cactus Landfill | Allen Road between Tucson Boulevard and Cactus Road | More information is needed regarding operational history, boundaries, waste depth, and characterization to assess potential impacts. |
| Walnut Landfill | South bank of Rillito River, north of Alvernon Way | High levels of methane gas have been documented. Long-term landfill gas and groundwater monitoring are required to determine impact on study area. |
| Various wildcat dump areas | Rillito River channel in vicinity of Columbus Landfills | Debris observed included construction debris, solid waste, and several piles of suspect asbestos containing pipes. |
| River Road Nursery | 2450 River Road | Materials observed include plastic, wood, and metal debris and containers. |
| Selected private properties north of Rillito River | 1. 3605 N. Edith Rd.<br>2. 3536 N. Edith Rd.<br>3. Unknown address with large excavation<br>4. Unknown address with construction debris | Materials observed include waste disposal, junk automobiles and parts, wood and metal scrap materials, heavy equipment, and an above ground storage tank. Potential HTRW concerns are solvents, pesticides, petroleum hydrocarbons, and asbestos. |
| Aggregate Sand and Gravel, formerly Columbia Sand and Gravel | 4326 River Road | Potential historic waste disposal in excavated areas and petroleum hydrocarbons from heavy equipment operation. |
| Kleindale Industrial District | Area south of the Rillito River, north of Kleindale Road, west of Alvernon Way, east of Kelvin Blvd., including N. Dodge Blvd. | Current and historic facilities of concern include gas station, auto body, repair and painting, cabinet manufacturing, pest control, concrete manufacturer, power plant substation, wood working, metal finishing, fiberglass, construction, and paint and manufacturing. |
| University of Arizona Campus Agricultural and Research Laboratories | Adjacent to south bank of Rillito River, east of Campbell Avenue, north of Rodger Road. | Research facilities of concern include fill piles, chemical use and waste disposal, and above ground storage tanks. |

SOURCE: Hazardous, Toxic, and Radioactive Waste (HTRW) Framework Research Report in support of Feasibility Study for the Proposed El Rio Antiguo Ecosystem Restoration Project. Prepared for U.S. Army Corps of Engineers by URS Corporation, March 2002.

### 4.10.3.4 Occupational Safety and Health Administration (OSHA)

OSHA is the primary federal agency responsible for worker safety in the handling and use of chemicals in the workplace. The employer is required to monitor worker exposure to listed hazardous substances and notify workers of exposure. These regulations specify requirements for employee training, availability of safety equipment, accident-prevention programs, and hazardous substance exposure warnings.

Federal Environmental Databases pertaining to HTRW that were searched as part of the report in Appendix G include:

- National Priorities List (NPL or Superfund)
- Comprehensive Environmental Response
- Compensation and Liability Information System (CERCLIS) List
- Resource Conservation and Recover Act (RCRA) Treatment, Storage, and Disposal (TSD) Facilities lists including facilities with (CORRACTS) Corrective action against them by the U.S. EPA.
- RCRA generators lists
- Emergency Response Notification System (ERNS)

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### 4.10.3.5 State

The Arizona Department of Environmental Quality is responsible for implementing federal regulations throughout the state. State regulations must be at least as stringent as the federal regulations and Arizona has adopted amendments to 40 Code of Federal Regulations to implement these regulations at the state level.

State HTRW databases that were searched as part of the HTRW report in Appendix G include:

- WQARF
- Arizona CERCLIS information and data system
- Arizona Superfund, formerly ACIDS
- Arizona solid waste facilities, registered underground storage tanks (USTs) and reported leaking underground storage tanks (LUSTs)

- Hazardous Incident Reports
- ADWR well registry
- ADEQ Dry Well Database and records of Environmental Permits

## 4.10.4 References

AJAY Environmental Consultants
1993 *Environmental Assessment Report for Rillito River Right-Of-Way Between Dodge Boulevard and Swan Road, Pima County, Arizona.* Prepared for Pima County Department of Transportation and Flood Control District by AJAY Environmental Consultants, INC., Tucson AZ, August 9, 1993.

Camp Dresser McKee
1990

CDM
1990 *Rillito Creek Recharge Feasibility Study, Interim Report, Environmental and Archaeological Characterization. Final Report, Phase A Task 76.* Camp Dresser and McKee Inc, 1990.

Davidson, E.S.
1973 *Geohydrology and Water Resources of the Tucson Basin, Arizona.* U.S. Geological Survey Water Supply Paper 1939-E.

Hanson, R. T., and J. F. Benedict
1994 *Simulation of Groundwater Flow and Potential Land Subsidence, Upper Santa Cruz Basin, Arizona.* U.S. Geological Survey Water Resources Investigation Report 93-4196.

PAG
1989 *****

2000 *Columbus Landfill, Environmental Data Summary.* Prepared by Pima Associations of Governments for Pima County Flood Control District. April 2000.

PCDOT and FCD
1996 ****

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URS Corporation
2002 HTRW Framework Research Report in support of Feasibility Study for the Proposed El Rio Antiguo Ecosystem Restoration Project. URS Project No. E2-00002096.00. Prepared for U.S. Army Corp of Engineers by URS Corporation, March 2002.

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# 4.11 Socioeconomics

## 4.11.1 Introduction

This section presents an economic evaluation of the benefits and costs associated with flood control, habitat restoration, and recreation opportunities in the El Rio Antiguo study area. Additional details and information can be found in the economics report in Appendix E.

## 4.11.2 Environmental Setting

### 4.11.2.1 Population

Pima County has experienced a rapid rate of population growth over the past 50 years with most of the concentrations of population growth occurring in and around Tucson. The El Rio Antiguo study area is included in the Tucson-Pima County Metropolitan Statistical Area (MSA). According to the 2000 Census, the Tucson-Pima County MSA population was approximately 843,700. In 1990, the population was approximately 666,800, and in 1980 it was 531,400. The area has experienced a 25.5 percent increase in population from 1980 to 1990, and a 26.5 percent increase from 1990 to 2000. The Tucson-Pima County MSA has been growing at an average annual compound rate of about 2.60 compared to the national average of 1.1 percent. Future population estimates are projected to be around 1.2 million by 2020.

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The Pima County population growth has been due primarily to net migration into the area. Two main factors contributing to the migration are employment opportunities and the low cost of housing. Because Pima County offers high-skilled technical and professional jobs and a diversified occupational base, some people may find the area appealing. Residents also can purchase low-cost housing, another lure, that may enhance their quality of living.

### 4.11.2.2 Employment

The years since World War II have witnessed the transition of Tucson from a railroad wayside with an economy dependent upon the three Cs (copper, cattle and cotton) into a sprawling western city with a much more diverse social and economic base. A Tucsonian is now likely to be employed in the government sector, by a technology-based manufacturer, or by a service-based industry, while development and construction continue to be mainstays of the local economy.

Today, there are three primary areas of employment in Pima County: education, government, and military. Employment in the educational sector includes the University

of Arizona, Pima County Community College, and the Tucson Unified School District. Employment in the government sector includes state, county, and city offices. Davis-Monthan Air Force Base and Raytheon Missile Systems Company offer employment in the military sector. Table 4.11-1 lists the major employers in Pima County. Table 4.11-2 lists the occupation type of employees in Pima County. The largest group of employees, professional and technical workers, account for 25 percent of the workforce. The three areas of employment, education, government and military, account for a portion of this 25 percent of professional and technical occupations in Pima County. This area typically requires a higher level of professional and technical skills, as well as a college education.

Pima County has had a low unemployment rate, sometimes as much as 1.4 to 1.8 percentage points below the Arizona and United States rate. In 1998, unemployment was 2.7 compared with Arizona at 4.1 and the United States at 4.5. This low unemployment rate may be attributed to, in part, the availability and demand for higher paying jobs in the professional and technical professions, as well as the supply of employees in this particular sector of the workforce.

Pima County's industrial sectors can be described by their general geographic distribution. The majority of agricultural production is located in the two main farming areas of Marana-Cortaro and Avra Valley. Mining operations are found outside of the urban areas while construction and manufacturing take place within the urban core. Service-providing employment is spread throughout the urban areas with a growing presence in suburban areas. Government civilian employment positions are mainly located in the downtown city section of Tucson, while much of the government military employment is on the Davis-Monthan Air Force Base. The University of Arizona also contributes significantly to the local economy.

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### 4.11.2.3 Housing

To accommodate the population expansion in the area, about 348,508 housing units were constructed in Pima County in 1999. This figure is up from 298,207 in 1990. According to the 1999 American Community Survey Profile for Pima County, Arizona, about 21 percent of the housing stock has been constructed in the past 10 years in Pima County. Most of the newer homes, constructed in master planned communities, are reasonably priced compared to other metropolitan areas. The average cost of a new single-family home is about $109,100, and this is a primary factor making the overall cost of living in Pima County among the lowest of major U.S. metropolitan areas.

**TABLE 4.11-1**
**EMPLOYERS, EMPLOYMENT TYPE, AND NUMBER OF EMPLOYEES**

| Employer | Employment Type | Number of Employees |
|---|---|---|
| University of Arizona | University of Colleges | 10,520 |
| State of Arizona | Government | 9,684 |
| Davis-Monthan Air Force Base | Military | 8,352 |
| Tucson Unified School District | Education | 8,187 |
| Raytheon Missiles Systems Co. | Military Manufacturing | 7,700 |
| Pima County | Government | 7,028 |
| City of Tucson | Government | 5,497 |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

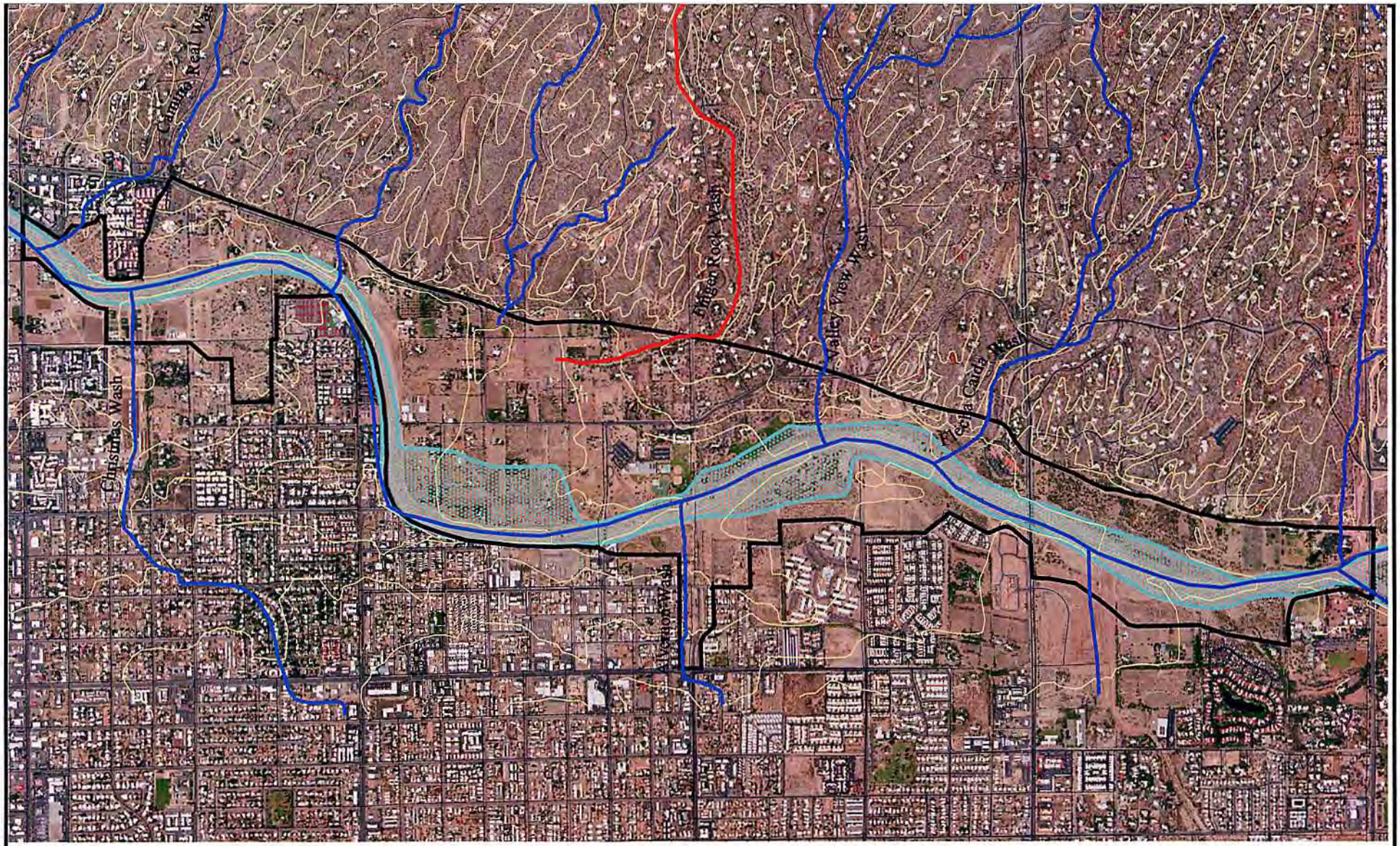


Image Source: 2001 AirPhotoUSA (flown October 1999)

RECON

Study Area

Major and minor streets

20 ft topographic contours

Finger Rock Wash

Washes

Floodway

0 Mile .4

# FIGURE 4.11-1

**Overview of Washes and Floodway in the El Rio Antiguo Study Area**

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**TABLE 4.11-2**
**PERCENTAGE OF EMPLOYEES BY OCCUPATION**

| Occupation | Percentage of Total Employees |
|---|---|
| Managers and administrative | 6.13 |
| Professional and technical | 24.7 |
| Sales and related occupations | 11.54 |
| Clerical and administrative support | 16.75 |
| Service occupations | 20.09 |
| Agriculture, forestry, and fishing | 0.55 |
| Production, maintenance, and material | 20.23 |
| TOTAL | 100.00 |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

# 4.11.3 Flood Control Analysis

## 4.11.3.1 Floodplain Description

The Finger Wash area, located on the north side of the Rillito River between Valley View Wash to the east and Country Club Road to the west, is under study for flooding. Flooding in this area commingled from both the Rillito River and Finger Wash. Figure 4.11-1 shows the general area.

## 4.11.3.2 Economic Assessment

An economic assessment was performed that included field surveys, inventories, evaluations of structures, contents and potential damage, as well as emergency response and traffic damages. Field surveys included a 100 percent survey by hand level. Recorded items included relative first floor elevation (FFE), structure type, address, the number of structures, class, the number of stories, structure condition, and structure use. Inventoried floodplain structures were categorized into single-family residence, mobile home, multiple-family residence (quadraplex, mixed, condos), commercial (nursery, auto shop), and public (government, religious). Inventories may include more than one structure on a parcel, since property delineations are by parcel and not by structure. Table 4.11-3 lists the category and number of structures. The value of structures in the floodplain was estimated field survey data, square footage estimates, and structure replacement value multipliers. In addition, the content values were estimated using a program that inputs zip code, square footage, type of establishment, estimated revenue, and the number of employees. Content ratios were derived as a percentage of corresponding replacement values of structures. Table 4.11-4 provides a detail of the total structure value and content value by category.

Structure and content damage evaluation was done using methodology used to compute the damages expected to be sustained in the floodplain area under study. Methodology included estimations of first-floor elevations, average flood depths, cross sections associated with a flood depth for specific event, inundation depths. Structure and content damages were estimated as a percentage of total structure and content values based on the Federal Emergency Management Act (FEMA) and the Economic Guidance Memorandum (EGM) 01-03: Generic Depth-Damage Relationships. Table 4.11-5 details structure and content damages by event for existing without project conditions.

Emergency response estimates are based on estimates derived from the January 1993 Flood Damage Summary Report by Pima County. Estimates include the costs to residents as they evacuate, relocate, and reoccupy their residence during a flood event. Based on estimates from the January 1993 flood, temporary relocation costs were $1,400 per resident. This estimate was applied to the number of residences in the 500-year floodplain and was used along with a non-damaging frequency of a two-year event to

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**TABLE 4.11-3**
**NUMBER OF PARCELS IN THE FINGER WASH AREA**

| Category | Number of Structures |
|---|---|
| Single-family residence | 67 |
| Mobile home | 1 |
| Multiple-family residence | |
| Quadraplex | 1 |
| Mixed | 2 |
| Condos | 27 |
| Commercial | |
| Nursery | 12 |
| Auto Shop | 1 |
| Public | |
| Government | 7 |
| Religious | 3 |
| TOTAL | 121 |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

**TABLE 4.11-4**
**STRUCTURE AND CONTENT VALUES FOR EL RIO ANTIGUO**
**(OCTOBER 2002 PRICE LEVELS)**

| Category | Square Feet | Average Square Feet | Structure Value | Average Structure Value | Content Value | Average Content Value |
|---|---|---|---|---|---|---|
| Single-family home | 161,765 | 2,414 | $8,353,213 | $124,675 | $4,176,606 | $62,337 |
| Mobile home | 3,093 | 3,093 | $97,192 | $97,192 | $48,596 | $48,596 |
| Multiple-family residence | | | | | | |
| Quadraplex | | | | | | |
| Mixed | 3,345 | 3,345 | $132,911 | $132,911 | $66,456 | $66,456 |
| Condos | 12,208 | 6,104 | $556,944 | $278,472 | $278,472 | $139,236 |
| | 261,071 | 9,669 | $13,209,724 | $489,249 | $6,604,862 | $244,625 |
| Commercial | | | | | | |
| Nursery | 3,117 | 260 | $1,050,621 | $87,552 | $1,124,164 | $93,680 |
| Auto Shop | 5,179 | 5,179 | $157,196 | $157,196 | $168,200 | $168,200 |
| Public | | | | | | |
| Government | 14,971 | 2,139 | $1,151,041 | $164,434 | $276,250 | $39,464 |
| Religious | 9,796 | 3,265 | $700,762 | $233,587 | $168,183 | $56,061 |
| TOTAL | 474,545 | 3,922 | $25,409,605 | $209,997 | $12,911,789 | $106,709 |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

**TABLE 4.11-5**
**ESTIMATED DAMAGES BY YEAR AND STRUCTURE TYPE**

| Reach | Residential | | | Nonresidential | | Total |
|---|---|---|---|---|---|---|
| | SFR | MH | MFR | Commercial | Public | |
| Structure | | | | | | |
| 2 year | $902,517 | $9,758 | $1,044,409 | $221,634 | $187,037 | $2,365,355 |
| 5 year | $1,069,212 | $9,758 | $1,245,876 | $221,634 | $252,935 | $2,799,416 |
| 10 year | $1,203,267 | $26,252 | $1,495,973 | $273,640 | $278,765 | $3,277,898 |
| 50 year | $1,479,845 | $26,252 | $1,561,406 | $281,421 | $346,193 | $3,695,116 |
| 100 year | $1,485,331 | $26,252 | $1,666,496 | $281,421 | $346,193 | $3,805,693 |
| 500 year | $2,725,377 | $73,215 | $2,662,414 | $478,047 | $610,377 | $6,549,430 |
| Total | $8,865,549 | $171,487 | $9,676,574 | $1,757,797 | $2,021,500 | $22,492,908 |
| Equivalent Annual Damages (EAD) | | | | | | $1,436,426 |
| Content | | | | | | |
| 2 year | $280,620 | $1,643 | $315,661 | $181,319 | $32,153 | $811,396 |
| 5 year | $324,225 | $1,643 | $372,242 | $181,319 | $46,324 | $925,752 |
| 10 year | $359,366 | $7,299 | $437,915 | $221,339 | $50,921 | $1,076,841 |
| 50 year | $431,718 | $7,299 | $455,100 | $227,327 | $63,449 | $1,184,893 |
| 100 year | $433,159 | $7,299 | $482,699 | $227,327 | $63,449 | $1,213,933 |
| 500 year | $755,695 | $32,652 | $742,545 | $376,499 | $108,953 | $2,016,344 |
| Total | $2,584,783 | $57,835 | $2,806,162 | $1,415,130 | $365,248 | $7,229,159 |
| Equivalent Annual Damages (EAD) | | | | | | $476,086 |
| Total Equivalent Annual Damages (EAD) | | | | | | $1,912,512 |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

SFR = single-family residential

MH = mobile home

MFR = multiple-family residential

perform equivalent annual damages. The equivalent annual damages (EAD) to residents due to flooding along Finger Wash are $41,180.

Traffic damages are estimated as a single event assuming traffic flow will be disrupted for a day no matter what the duration. This is because the method used to compute overflows does not allow for a means to estimate the duration of flooding by flood events, so the traditional methods of computing traffic damages could not be used. According to the analysis, the flooded areas could cause temporary closures of River Road between Country Club Road and Valley View Wash. Based on the estimated detour miles, and vehicles per day, the detour speed, and time involved, and traffic delay costs, the estimated potential damage resulting from delays is approximately $19,700 annually, which does not include the estimated vehicle operation costs around $4,300 annually.

### 4.11.3.3 Hydrogeomorphic Methodology (HGM) Analysis

The hydrogeomorphic methodology approach was used to assess the environmental conditions, particularly the wetland functions, of the Rillito River for both the current and future with no project conditions. The HGM approach was developed by scientists at the Engineering Research and Development Center (ERDC) under its wetlands research program. The HGM approach extends beyond the ecological processes of properties and characteristics, to the functional capacity of the wetlands. The concept is based on the biological processes that impact the traits we associate with natural ecosystems. The HGM model defines the relationship between many ecosystem interactions with the intentions of expressing the dynamic functional capacity of a wetland.

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With the HGM model, the functional capacity of a wetland is expressed as an index, Functional Capacity Index (FCI), which is based on a standard from zero to one. Zero represents a low functional capacity, and one represents a high functional capacity for the wetland. The FCI can be used to determine the Functional Capacity Units (FCUs). The FCU is a measure of environmental output, or the ability of a wetland to perform a certain function. The FCU is calculated by multiplying the FCI by the area of the wetland. In order to develop a benefit-cost ratio, a program (IWR Plan) is used to combine FCUs with associated costs to determine cost-effective solutions.

### 4.11.3.4 Recreation

The recreation discussion includes information on existing parks in the study area, along with future parks and restored recreational areas planned for the area. There are six parks in close vicinity of the Rillito River in the Rio Antiguo study area, in addition to the Rillito River Park. The Rillito River Park is discussed in detail since it plays such a prominent position, not only because it is in the study area, but also because of the future plans for other parks to be linked to the Rillito River Park. Recreational demand and the

unit day value method is used to discuss and support the development of these future parks and restored recreational areas along the Rillito River.

Parks in the vicinity of the Rillito River and the study area include Fort Lowell Park, La Madera Park, McCormick Park, North Central Park, Murphey Multi-Use Field, and George Mehl Foothills District Park. Most parks offer multiple use fields for soccer, baseball, softball, along with restrooms, drinking fountains, playgrounds, and picnic ramadas. Fort Lowell Park even offers racquetball, tennis, and volleyball courts, in addition to a swimming pool, and McCormick Park offers an amphitheater.

Rillito River Park begins at Craycroft Road, continues through the study area, all the way to Interstate 10, a total of 11.2 miles of River Park. Even though the park functions as a continuous park, it was completed in segments. Sections of the park include Children's Memorial Park, an exercise course, rest rooms, parking, art projects, and multiple use trails for pedestrians, equestrians, and bicyclists. The trails of Rillito River Park will eventually link with a system of trails, some of which are not yet developed, along the Santa Cruz River, Rillito River, Tanque Verde Creek, Pantano Wash, and Canada del Oro Wash. Table 4.11-6 lists visitation figures for sections of Rillito River Park by month for two years, 1999 and 2000. The many benefits of the Rillito River Park include, but are not limited to, the establishment of a continuous corridor that contributes to a regionwide trail system, maintenance and enhancement of wildlife corridors, educational opportunities, enhancement of property values, economic development and tourism, and encouragement of alternative modes of transportation.

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The City of Tucson is planning for the development of four parks along or near the El Rio Antiguo study area on the Rillito River. The parks, most parks will link to the Rillito River, include Campbell Alvernon Linear Park, Rillito Park at River Bend, Rillito Park at Columbus Boulevard District Park, and North Central Natural Resource Park. The proposed riparian habitat area along the El Rio Antiguo study area is attractive in terms of recreation potential and unmet demand for many factors including recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental.

A common method for assessing community demand and the need for open space and recreation is the use of population-based standards set by the National Recreation and Parks Association (NRPA). The City of Tucson describes national standards for park type (mini park, neighborhood park, community park, metro park, and regional park), and compares the standards to current service levels set by the City of Tucson for the core/mid-city region, and the edge/future city region. These standards are often used to determine whether the supply of recreational resources is lacking behind the demand that is supported by population growth.

**TABLE 4.11-6**
**ATTENDANCE FOR RILLITO RIVER PARK**

| Month | Campbell Avenue | | Children's Memorial Park | | 1st Avenue | |
|---|---|---|---|---|---|---|
| | 1999 | 2000 | 1999 | 2000 | 1999 | 2000 |
| January | 2,478 | 5,173 | 20,332 | 12,473 | 9,936 | 8,790 |
| February | 1,598 | 5,470 | 14,957 | 15,359 | 10,748 | 11,961 |
| March | 1,014 | 7,789 | 14,394 | 17,857 | 7,729 | 10,236 |
| April | 7,243 | 3,208 | 24,057 | Broken | 1,613 | 12,699 |
| May | 1,562 | 6,704 | 11,718 | 6,889 | 4,309 | 4,341 |
| June | 7,979 | 6,486 | 2,694 | 5,754 | 2,193 | 4,696 |
| July | 2,041 | 2,991 | 8,266 | 2,268 | 2,701 | 3,464 |
| August | 2,873 | 4,204 | 8,209 | 4,240 | 4,086 | 3,236 |
| September | 111 | 4,847 | 7,361 | 7,771 | 5,708 | 5,511 |
| October | 1,626 | 6,327 | 11,838 | Broken | Broken | 6,327 |
| November | 542 | 2,798 | 7,683 | 4,391 | 1,098 | 5,790 |
| December | 8,331 | 9,030 | 13,623 | 19,621 | 10,284 | 7,331 |
| TOTAL | 37,398 | 65,027 | 145,132 | 96,623 | 60,405 | 84,382 |
| Average | 51,212 | | 120,877 | | 72,393 | |

SOURCE: U.S. Army Corps of Engineers 2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

NOTE: Attendance figures collected by Pima County Parks and Recreation Department using laser counting device.

According to national and City of Tucson standards, existing metro parks have met population needs in the core/mid-city area but not the edge/future city region. Regional parks have met demand for the core/mid city area but not the edge/future city. Table 4.6-2 in the Recreation section lists the existing and future demand for acres of parks according to type. The estimated number of park acres needed to meet anticipated population growth by 2010 is 2,480, along with an estimate of 27 miles of multi-use path.

### 4.11.3.5 Evaluation of the El Rio Antiguo Study Area

The recreational features along the El Rio Antiguo study area can be evaluated in terms of economics using the unit day value (UDV) analysis method. This method involves criteria (recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental), key variables (number of activities, number of similar activities nearby, adequacy of facilities, ease of access, and aesthetic quality), along with value range and point values for the criteria. This process is explained in Appendix E. Point values can be converted into an equivalent dollar amount. Point values for the portion of Rillito River Park that is located within the El Rio Antiguo study area are estimated. For the El Rio Antiguo study area, the UDV amount is $4.45 per day. This UDV amount represents how much a visit to the park is worth in dollar amount for the without project condition. When multiplied by the annual number of visitors, the result is an estimate of annual recreation value. Average annual visitation to Rillito River Park at Campbell Avenue is approximately 51,200 (The visitation figures for 1st Avenue and Children's Memorial Park are not used because they are outside of the study area.). The estimated annual recreation value of the park within the El Rio Antiguo study area is approximately $227,800. These numbers do not consider any possible future expansion of the park and are assigned using information described in Appendix E.

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## 4.11.4 References

U.S. Army Corps of Engineers
2002 Feasibility Report for El Rio Antiguo, Economic Appendix. March.

# 4.12 Utilities

## 4.12.1 Introduction

This section describes the existing public utilities and public services that are provided by the various agencies within the study area.

## 4.12.2 Environmental Setting

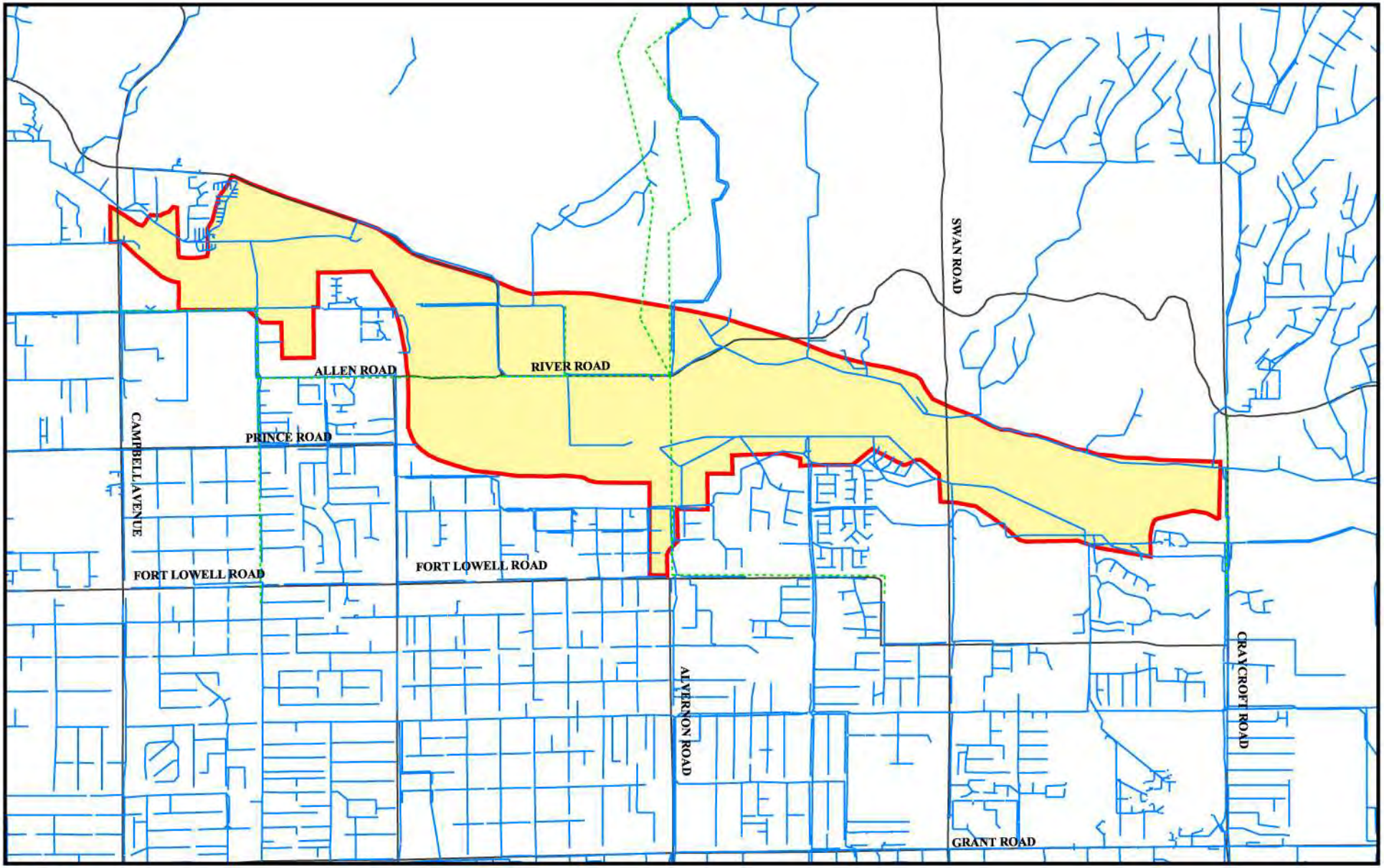
The area surrounding the El Rio Antiguo study area is both urban and residential. Infrastructure includes water supply, sewer and wastewater service, electricity, and natural gas. The approximate jurisdictional boundary between the city of Tucson and Pima County is the Rillito River. Pima County's jurisdiction includes the river and the general area to the north, and south of the Rillito River is under the City of Tucson's jurisdiction. Jurisdictional boundaries apply for services such as waste pickup and recycling, while other services extend beyond jurisdictional boundaries, such as sewer and water, and especially for private companies providing electricity and natural gas.

### 4.12.2.1 Water Supply

Tucson Water is a department of the City of Tucson and operates as a utility for serving both potable and non-potable water to the Tucson and eastern Pima County areas. Tucson Water provides water service to most city residents as well as a large number of other area communities. Tucson Water serves nearly 675,000 customers. The infrastructure necessary to do this includes approximately 3,500 miles of pipelines and more than 20 large reservoirs. While the major source of water continues to be groundwater, Tucson Water is using imported CAP water (Central Arizona Project) for agriculture, and is developing several recharge projects to augment groundwater supply.

### 4.12.2.2 Sewer and Wastewater Service

Pima County Wastewater Management operates the sewer system in the metropolitan Tucson area, including the city of Tucson. Figure 4.12-1 shows some of the sewer and reclaimed water infrastructure in the study area. Wastewater coming from the area south of the Rillito River is treated at the Roger Road Treatment Plant. Wastewater coming from the area north of the Rillito River is serviced by the Ina Road Treatment Plant. The Roger Road Treatment Plant is the closest to the El Rio Antiguo study site, located approximately seven miles to the west. Discharged water from the treatment plants does not occur in the vicinity of the study site, and has no direct impact on the study area, so public health and safety concerns regarding treatment plants are limited.

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Study area
Major Streets
Reclaimed Water
Sewer Pipe

# FIGURE 4.12-1

**Sewer and Reclaimed Water Infrastructure in the El Rio Antiguo Study Area**

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Individual septic systems are typically used in situations where connection to a public wastewater system is not feasible, or where housing density is low. Because the study site is in the metropolitan area of Tucson, and most facilities have readily access to the public sewer system, public health and safety concerns regarding septic systems are limited.

### 4.12.2.3 Electricity and Natural Gas

Electricity in the Tucson and Pima County area is provided by Tucson Electric Power. One of the most noticeable aspects of the study area is the Tucson Electric Power substation and power lines by Dodge Boulevard. The substation is on the south bank adjacent to the Rillito River, and for much of the study area, the power lines extend from this substation and run along the center of the riverbed, supported by poles.

Southwest Gas Corporation provides energy services to the Tucson and Pima County areas. Southwest Gas delivers clean, efficient natural gas to homes, residences, and businesses in the study area and surrounding areas. Strong growth in the southwest has made Southwest Gas one of the fastest growing natural gas utilities in the U.S.

## 4.12.3 Regulatory Setting

### 4.12.3.1 Arizona Corporation Commission

This commission was created by the Arizona Constitution and has regulatory responsibility for utilities, as well as railroad and pipeline safety. This commission is responsible for final decisions on granting or denying rate adjustments, enforcing safety and public service requirements, and approving securities matters.

## 4.12.4 References

Websites for the following organizations were accessed for information.

Arizona Corporation Commission - www.cc.state.az.us/about/index..htm

City of Tucson - www.ci.tucson.az.us

Pima County - www.co.pima.az.us

# 4.13 Transportation

## 4.13.1 Introduction

This section discusses the transportation system that exists within the vicinity of the El Rio Antiguo study area. A general description of the physical system is provided along with current roadway counts and the regulatory setting.

## 4.13.2 Environmental Setting

### 4.13.2.1 Regional Overview

Pima Association of Governments is the designated Metropolitan Planning Organization (MPO) for eastern Pima County, which means that it is responsible for regional transportation planning activities, including determining the allocation of federal dollars. In addition, PAG is responsible for assuring that transportation plans are financially feasible, conform to air quality requirements, provide for an accessible, multi-modal transportation system, and are developed using proactive and inclusive public involvement process. The PAG planning region includes the six PAG-member jurisdictions: City of Tucson, City of South Tucson, Pima County, Towns of Marana, Oro Valley, and Sahuarita. The PAG planning region also includes that portion of unincorporated eastern Pima County and the San Xavier District of the Tohono O'odham Nation and portions of the Pascua Yaqui Nation. The PAG transportation planning area included the City of Tucson, the City of South Tucson, Marana, Sahuarita, Oro Valley, and eastern Pima County. PAG is not a governmental agency, so the responsibility for building and operating the transportation infrastructure lies with PAG's member jurisdictions. Each jurisdiction typically has its own transportation department and staff associated with planning, building, and operating the transportation system.

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PAG's regional transportation planning process has two key components, the long-range (20- to 25-year) Regional Transportation Plan (RTP) and the short-range (5-year) Transportation Improvement Program (TIP). The RTP is a long-range plan that guides improvements to the region's bus, roadway, bicycle, pedestrian, aviation, and rail transportation system, whereas the TIP is a short-range plan that identifies and prioritizes projects to be funded for construction during the next five-year period. In addition to the RTP and TIP, PAG coordinates the development of a wide variety of other regional plans and programs such as the Congestion Management System Plan, the Intelligent Transportation System Strategic Deployment Plan, the Regional Aviation System Plan, the Bicycle Plan, the Pedestrian Plan, the Intermodal Management System Plan, the Traffic County Program, the Travel Reduction Program, and RideShare, along with others.

The regional roadway system in eastern Pima County consists of approximately 4,000 lane-miles of freeways, parkways, and major and minor arterial roadways. PAG estimates that this roadway system provides for approximately 85 percent of the total vehicle miles traveled in the Tucson metropolitan area.

Over the past several years, Pima County has experienced an increase in population, traffic congestion, automobiles per household, daily vehicle miles traveled per person, and peak traffic hours. While the population has increased approximately 10 percent, travel demand has increased over 13 percent; however, the lane miles of roadway capacity has increased only one percent. In addition to the increase in vehicle miles traveled (VMT), there has also been an increase in the vehicle hours traveled (VHT), so trips take longer. Travel demand has increased faster than population growth, and population growth has increased faster than roadway capacity and the ability to provide system improvements. This leads to congestion. Over 25 percent of the vehicle miles traveled (VMT) are under heavy to severe congestion.

PAG initiated the Mobility Management Plan (MMP) to monitor congestion and to assist with projects that will improve the efficiency of the transportation system. PAG evaluates intersection performance by traffic delay and traffic volume using time-based performance measures. Figure 4.13-1 shows busy intersections that have long delay per vehicle, and busy intersections that have high average daily traffic volumes. Table 4.13-1 lists busy intersections in the Tucson area according to the delay per vehicle. The intersections are ranked in order for the year 2000, with the intersection having the longest delay listed first. The intersections correspond with the intersection shown in Figure 4.13-1. Table 4.13-2 lists the busy intersection according to high average daily traffic volumes. Intersections are ranked in order for the year 2000, with the intersection having the highest average daily traffic listed first. Once again, these intersections correspond with the intersections identified in Figure 4.13-1. It is no surprise that most intersections listed in Table 4.13-1 as having long delays are also listed in Table 4.13-2 as having high average daily traffic. However, it is important to note that some high-volume intersections do not necessarily result in long delays because they have improved lane capacity and configuration, as well as good signal timing. Conversely, intersections that tend to have high average vehicle delay with relatively low traffic volumes often have poor left-turn and through capacity. Figure 4.13-2 shows the El Rio Antiguo study area with average daily trips listed for many of the roadways in and around the study area. The important message from these tables and figures is that while the ranking of the busiest intersections may fluctuate from year to year, many of the busy intersections are consistently ranked for both delay and traffic volume. The general traffic pattern is one of increasing traffic volumes as well as increasing delays.

As part of long-range regional transportation planning, PAG implemented the Travel Reduction Program (TRP) to improve air quality and reduce traffic congestion by encouraging the use of alternate modes of transportation. Currently, approximately 30

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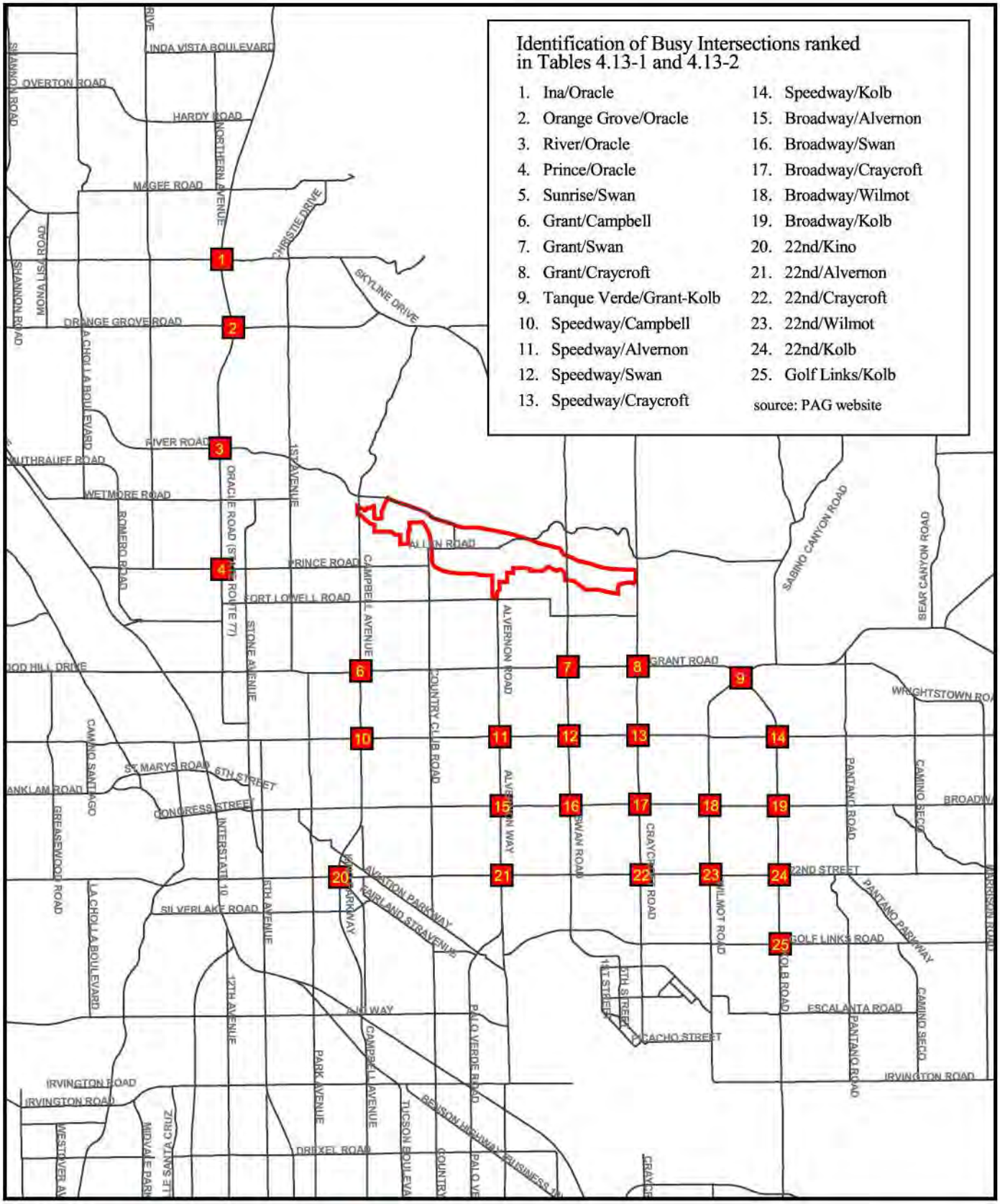


RECON

El Rio Antiguo study area

Busy intersections for delay and traffic volume

0 Miles 2

# FIGURE 4.13-1

## Busy Intersections for Delay and Traffic Volume

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**TABLE 4.13-1**
**BUSY INTERSECTIONS RANKED BY DELAY FOR THE YEAR 2000**

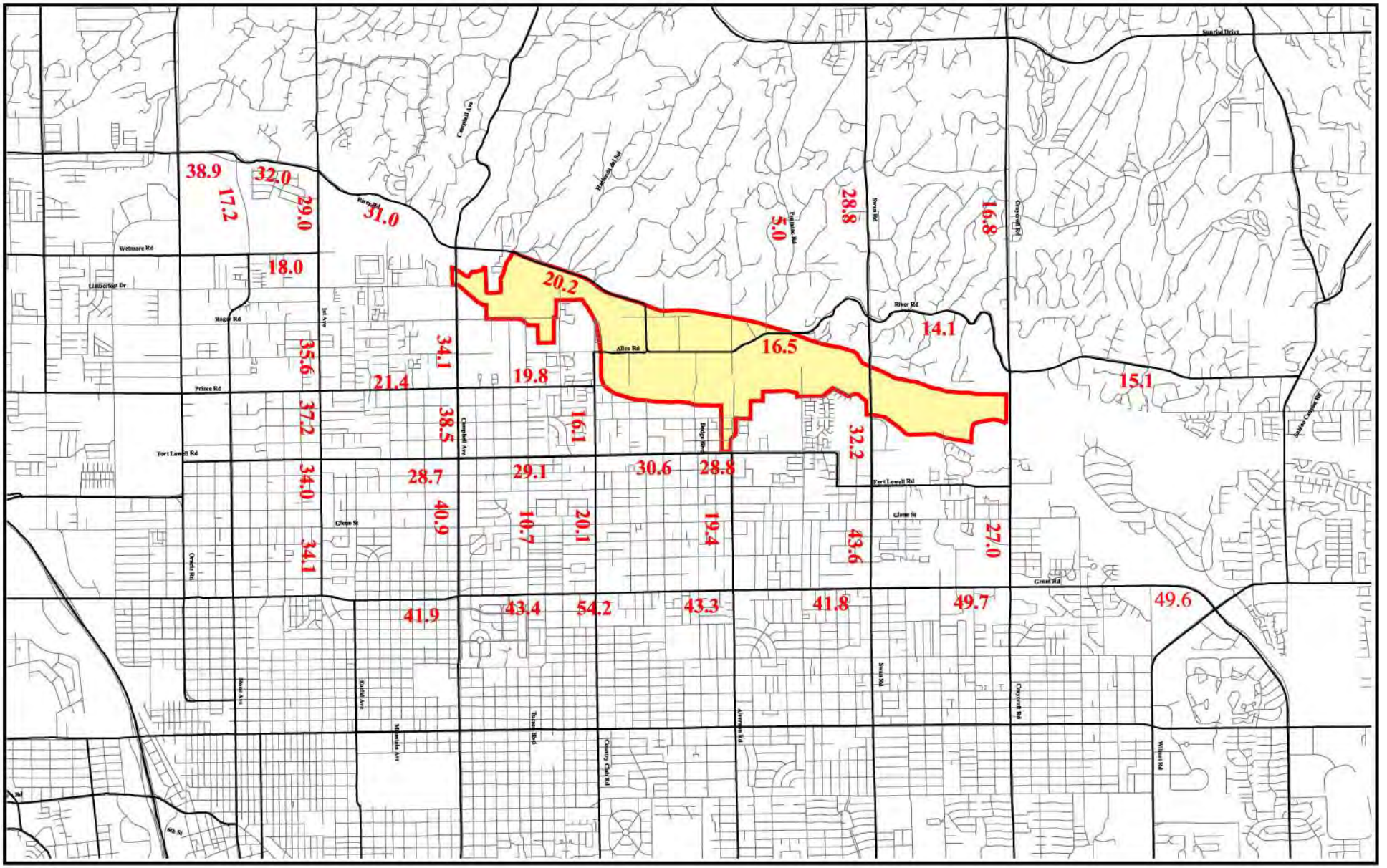
| Intersection | Delay (seconds per vehicle) 1997 | 1998 | 1999 | 2000 | Identification of Intersection on Figure 4.13-1 |
|---|---|---|---|---|---|
| 22nd Street/Kino | 30.1 | 23.2 | 26.5 | 50.4 | 20 |
| Golf Links/Kolb | 28.6 | 31.0 | 34.2 | 46.5 | 25 |
| Speedway/Swan | 23.3 | 43.1 | 34.7 | 43.7 | 12 |
| 22nd Street/Wilmot | 27.4 | 39.9 | 45.3 | 39.2 | 23 |
| Grant/Craycroft | 25.6 | 47.9 | 33.2 | 37.4 | 8 |
| Ina/Oracle | -- | 42.2 | 41.8 | 35.4 | 1 |
| T. Verde/Grant - Kolb | 44.4 | 36.9 | 34.1 | 35.3 | 9 |
| 22nd Street/Alvernon | 31.1 | 36.1 | 27.2 | 33.8 | 21 |
| Broadway/Kolb | 60.4 | 27.4 | 31.2 | 32.7 | 19 |
| Grant/Swan | 44.5 | 30.2 | 33.8 | 32.6 | 7 |
| Broadway/Craycroft | 28.4 | 33.6 | 36.2 | 32.6 | 17 |
| Speedway/Kolb | 48.7 | 27.6 | 29.1 | 31.9 | 14 |
| Broadway/Swan | 37.0 | 46.0 | 26.2 | 31.9 | 16 |
| Speedway/Craycroft | 27.2 | 36.8 | 31.0 | 31.7 | 13 |
| Orange Grove/Oracle | -- | 24.8 | 31.0 | 31.1 | 2 |
| Prince/Oracle | -- | 23.1 | 30.6 | 29.1 | 4 |
| 22nd Street/Craycroft | 24.5 | 26.8 | 26.0 | 29.1 | 22 |
| Sunrise/Swan | -- | 30.9 | 29.4 | 28.9 | 5 |
| Speedway/Campbell | 33.0 | 29.5 | 29.9 | 28.7 | 10 |
| River/Oracle | -- | 26.7 | 26.4 | 27.6 | 3 |

SOURCE: Pima Association of Governments 1995-2000 Regional Transportation System Performance Assessment. www.pagnet.org/TPD/rsp/rsp2000/roadway_congestion.htm.

**TABLE 4.13-2**
**BUSY INTERSECTIONS RANKED BY TRAFFIC VOLUME FOR THE YEAR 2000**

| Intersection | Average Daily Traffic Volumes | | | | Identification of Intersection in Figure 4.13-1 |
|---|---|---|---|---|---|
| | 1997 | 1998 | 1999 | 2000 | |
| Speedway/Campbell | 94,400 | 98,940 | 96,445 | 96,648 | 10 |
| Broadway/Kolb | 94,600 | 94,403 | 86,974 | 96,383 | 19 |
| T. Verde/Grant - Kolb | 91,600 | 91,240 | 84,187 | 94,827 | 9 |
| 22nd Street/Kolb | 90,400 | 91,436 | 83,679 | 92,817 | 24 |
| River/Oracle | -- | 74,523 | 83,312 | 88,081 | 3 |
| Broadway/Craycroft | 85,400 | 85,828 | 77,870 | 87,047 | 17 |
| Ina/Oracle | -- | 93,242 | 94,577 | 86,386 | 1 |
| Speedway/Alvernon | 84,400 | 90,646 | 86,609 | 85,815 | 11 |
| Broadway/Wilmot | 93,900 | 97,784 | 88,334 | 85,154 | 18 |
| Grant/Swan | 84,600 | 84,300 | 79,519 | 84,718 | 7 |
| Golf Links/Kolb | 77,200 | 83,497 | 83,679 | 84,285 | 25 |
| 22nd Street/Alvernon | 93,900 | 86,291 | 81,570 | 83,804 | 21 |
| Broadway/Swan | 86,300 | 86,763 | 78,937 | 83,754 | 16 |
| Speedway/Craycroft | 82,700 | 86,318 | 82,104 | 83,649 | 13 |
| Speedway/Swan | 83,600 | 92,109 | 87,032 | 83,555 | 12 |
| 22nd Street/Craycroft | 81,300 | 78,668 | 78,308 | 82,412 | 22 |
| Grant/Campbell | 80,200 | 88,352 | 81,314 | 81,954 | 6 |
| Speedway/Kolb | 79,600 | 85,555 | 82,084 | 81,301 | 14 |
| Grant/Craycroft | 79,000 | 87,370 | 71,693 | 81,241 | 8 |
| Broadway/Alvernon | 78,100 | 87,031 | 77,509 | 79,255 | 15 |

SOURCE: Pima Association of Governments 1995-2000 Regional Transportation System Performance Assessment. www.pagnet.org/TPD/rsp/rsp2000/roadway_congestion.htm

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0 Mile 1

Study area

43.4 Average Daily Trips in Thousands

Major Streets

Minor Streets

# FIGURE 4.13-2

**Existing Traffic Volumes in Study Area**

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percent of companies participate in the program. Other modes of transportation include Sun Tran, the major transit provider in the region, the RideShare program, which offers computerized carpool-matching services, bicycles, with an increasing network and facilities, and a regional pedestrian plan that facilitates a better network for pedestrians.

### 4.13.2.2 Road Functional Classification System

Functional classification is the grouping of streets and highways into classes or systems according to the character of service they are intended to provide in relation to the total public road system. The objective is to identify the most significant trip purpose for which the road is used such as moving traffic or providing land use access. The functional classification process is a practical technique for determining the travel corridors that best serve through and local traffic in an urban area. The process determines the importance of urban streets and highways in relation to one another and to urban development. The Arizona Department of Transportation along with local jurisdictions, classified public roads and streets in eastern Pima County according to functional systems. Four functional systems for urbanized areas are principal arterials, minor arterial streets, collector streets, and local streets.

The principal arterial system includes interstates, expressways, and other major roads. Principal arterial streets and highways serve as high-volume traffic corridors for long-distance travel, connecting the major generators of traffic. Principal arterials are typically the higher traffic volume streets that serve the major centers of activity of the metropolitan area. The principal arterial system streets and highways serve as traffic corridors connecting the major centers of activity of the metropolitan area.

There are a limited number of roads in eastern Pima County that are classified as principal arterial interstates and expressways. Interstates 10 and 19 are classified as principal arterials–interstates. Interstate 10 runs from the northwest corner of the Tucson Valley to the southeast corner, continuing east into Cochise County. Interstate 19 branches off Interstate 10 near South Tucson, and travels south into Santa Cruz County. Roads that are considered principal arterials–expressways include a portion of Golf Links Road, Aviation Expressway, and Kino Parkway. Golf Links Road, west of Kolb Road, travels west along the northern boundary of Davis-Monthan Air Force Base, where it continues northwest as Aviation Expressway into the downtown area of Tucson. Kino Parkway, north of Benson Freeway to Broadway Boulevard, is also classified as a principal arterial-expressway. A large proportion of roads are classified as principal arterial–other. Principal arterial–other roads traveling in the north-south direction include North Las Chollas Boulevard, North Oracle Road, North Miracle Mile, West Silverlake Road, South Tucson Nogales Highway, portions of Campbell Avenue, South Alvernon Way, Swan Road, Wilmot Road, Sabino Canyon Road, Kolbe Road, and South Houghton Road. Principal arterial–other roads traveling in the east-west direction include Ina Road,

West Orange Grove Road, Sunrise Drive, portions of River Road, Grant Road, Speedway Boulevard, Broadway Boulevard, East 22nd Street, Ajo Way, and East Valencia Road.

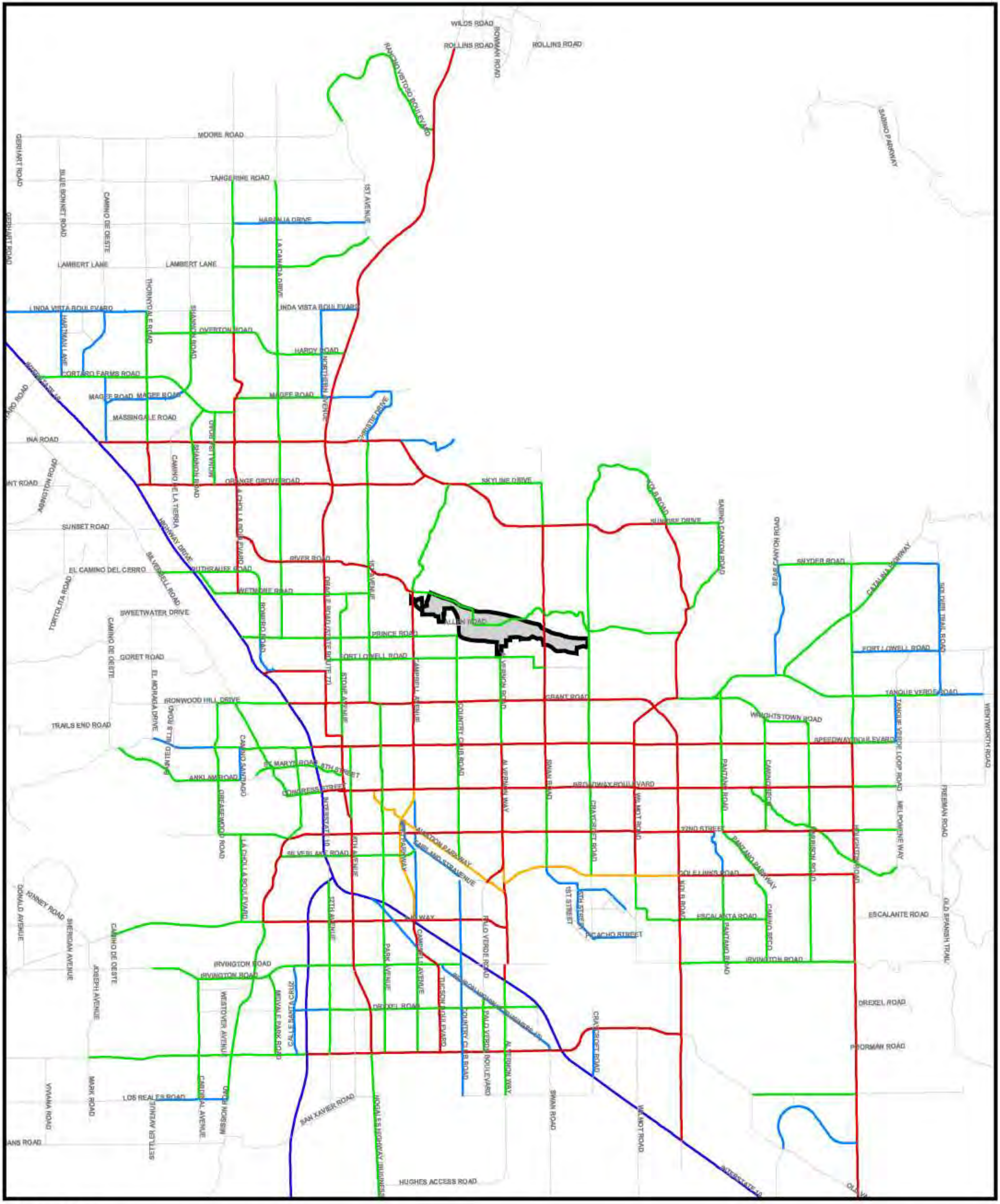
The minor arterial street system interconnects with and augments the principal arterial system. This system services trips of moderate length at a somewhat lower level of travel mobility than principal arterials. Minor arterial streets serve less concentrated traffic-generating areas, such as neighborhood shopping centers and schools, and distributes medium traffic volumes. Minor arterial streets serve as boundaries to neighborhoods and collect traffic from collector streets. A large proportion of roads in eastern Pima County are classified as minor arterial. Some of these roads include North Thorndale Road, North La Canada, Shannon Road, north Greasewood Road, Mission Road, First Avenue, Euclid Avenue, North Tucson Boulevard, North Country Club Road, Rosemont Boulevard, Craycroft Road, North Pantano Road, and Harrison Road traveling in the north-south direction. Minor arterial roads traveling in the east-west direction include West Overton Road, Cortaro Farms Road, Wetmore Road, East Skyline Drive, portions of River Road, Prince Road, Fort Lowell Road, East Tanque Verde Road, Catalina Highway, East Fifth Street, Escalante Road, and Irvington Road.

The collector street system provides both direct service to, and traffic circulation within residential neighborhoods, commercial and industrial areas. Collector streets are typically spaced at even intervals to collect traffic from local-access streets and channel it to principal and minor arterial streets. Collector streets have moderate to low traffic volumes and may serve as local bus routes. Collector streets traveling in the east-west direction include Linda Vista Boulevard, Rollercoaster Road, East Ina Road, Via Entrada, Rover Road, Glenn Street, University Boulevard, Bilby Road, and Stella Road. Collector streets traveling in the north-south direction include North Northern Avenue, Hacienda del Sol, Pontatoc Road, Bear Canyon Road, North Harrison Road, North Soldier Trail, Fairview Avenue, Mountain Avenue, Columbus Boulevard, Country Club Road, and South 6th Avenue.

Local access streets are those not selected for inclusion in the arterial or collector classes. They provide access to individual homes, shops, and similar traffic destinations. Local access streets offer the lowest level of mobility and usually contain no bus routes. There are far too many local access streets in eastern Pima County to list.

### 4.13.2.3 Local Roadway Network in the Study Area

The study area follows the Rillito River, generally in the east-west direction. To the south, the local road network is characterized by a grid roadway system. North of the Rillito River, due to the rolling topography of the Santa Catalina Foothills, the network of residential roads is irregular compared to the organized grid network of roads to the south. Figure 4.13-3 shows the roadway network in and around the study area, along with the functional classification of the roads. The western study area boundary is Campbell




El Rio Antiguo study area

Roadway Classification

- Principal Arterial - Interstate
- Principal Arterial - Expressway
- Principal Arterial - Other
- Minor Arterial
- Urban Collector

0 Miles 3

# FIGURE 4.13-3

**Functional Classification for Roadways in the Tucson Metropolitan Area**

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Avenue, and the eastern study area boundary is Craycroft Road. Other north-south roads in the study area are Dodge Boulevard, and Swan Road, both having bridges that cross the Rillito River. Campbell is classified as a principal arterial south of River Road, and as a minor arterial north of River Road. Swan Road is also classified as a principal arterial, while Craycroft Road is a minor arterial, and Dodge Boulevard is an urban collector. Prominent roads traveling in the east-west direction include River Road and Sunrise Drive north of the Rillito, and Fort Lowell Road, Grant Road, and Speedway Boulevard to the south. Sunrise is classified as a principal arterial, and River Road is a minor arterial, however, west of Campbell Avenue, River Road is classified as a principal artery. To the south, Fort Lowell Road is classified as a minor arterial, while Grant Road and Speedway Boulevard are principal arterials.

Busy intersections with high traffic volumes and long delays in the vicinity of the study area are depicted in Figure 4.13-1. These high volume intersections are south of the Rillito River and include Speedway and Campbell, Speedway and Swan, Speedway and Craycroft, Grant and Campbell, Grant and Swan, Grant and Craycroft, Broadway and Craycroft, and Broadway and Swan.

In the study area, the north-south roads, Campbell Avenue, Swan Road, and Craycroft Road, have approximately the same average daily trips, around 30,000. Table 4.13-3 lists the traffic volumes on local area roadways in and around the study area. However, Dodge Boulevard has only half that amount, approximately 16,000. The most heavily traveled portion of River Road is between Campbell Avenue and Dodge Boulevard, at 20,000, whereas the other segments of River Road have around 15,000 average daily trips. South of the Rillito River, Fort Lowell Road averages between 22,000 and 30,000 daily trips, while Grant Road is by far the busiest road, with 40,000 to 54,000 daily trips.

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### 4.13.2.4 Railroads

The railroad system in the Tucson area consists of both passenger rail (Amtrak) and freight service (Union Pacific Transportation Company). The railway runs generally parallel to Interstate 10 and along Interstate 19. While the railway does not pass directly through the study area, it does pass to the west of the study site by Interstate 10.

### 4.13.2.5 Airports

Airports within eastern Pima County include Marana Northwest Regional, Ryan Field, La Cholla Airpark, Davis-Monthan Air Force Base, and Tucson International. In addition to regularly scheduled passenger and cargo service provided by Tucson International, the other airports have special use activities that include recreational skydiving (Marana Northwest Regional), pilot training (Ryan Airfield), and military training at Davis-Monthan Air Force Base. La Cholla Airpark is a privately owned airport that services small aircraft.

**TABLE 4.13-3**
**TRAFFIC VOLUMES ON LOCAL AREA ROADWAYS**

| Roadway | From | To | ADT 1997-2001 (counts are in thousands) | Functional Classification System |
|---|---|---|---|---|
| Campbell Ave. | Prince Rd. | River Rd. | 34.1 | Principal Arterial |
| Campbell Ave. | River Rd. | Skyline Dr. | 15.1 | Minor Arterial |
| Dodge Blvd. | Ft. Lowell Rd. | River Rd. | 16.3 | Urban Collector |
| Swan Rd. | Grant Rd. | Ft. Lowell Rd. | 43.6 | Principal Arterial |
| Swan Rd. | Ft. Lowell Rd. | River Rd. | 33.2 | Principal Arterial |
| Swan Rd. | River Rd. | Sunrise Dr. | 28.8 | Principal Arterial |
| Craycroft Rd. | Grant Rd. | River Rd. | 27.0 | Minor Arterial |
| Craycroft Rd. | River Rd. | Sunrise Dr. | 16.8 | Minor Arterial |
| River Rd. | Oracle Rd. | First Ave. | 38.9 | Principal Arterial |
| River Rd. | First Ave. | Campbell Ave. | 31.0 | Principal Arterial |
| River Rd. | Campbell Ave. | Dodge Blvd. | 20.0 | Minor Arterial |
| River Rd. | Dodge Blvd. | Swan Rd. | 16.5 | Minor Arterial |
| River Rd. | Swan Rd. | Craycroft Rd. | 14.1 | Minor Arterial |
| River Rd. | Craycroft Rd. | Sabino Canyon | 15.1 | Minor Arterial |
| Ft. Lowell Rd. | First Ave. | Campbell Ave. | 28.7 | Minor Arterial |
| Ft. Lowell Rd. | Campbell Ave. | Country Club | 29.1 | Minor Arterial |
| Ft. Lowell Rd. | Country Club | Alvernon Way | 30.6 | Minor Arterial |
| Grant Rd. | First Ave. | Campbell Ave. | 41.9 | Principal Arterial |
| Grant Rd. | Cambell Ave. | Tucson Blvd. | 43.4 | Principal Arterial |
| Grant Rd. | Tucson Blvd. | Country Club | 54.2 | Principal Arterial |
| Grant Rd. | Country Club | Alvernon Way | 43.3 | Principal Arterial |
| Grant Rd. | Alvernon Way | Swan Rd. | 41.8 | Principal Arterial |
| Grant Rd. | Swan Rd. | Craycroft Rd. | 49.7 | Principal Arterial |

## 4.13.3 Regulatory Setting

The regulatory setting of the transportation network in the area is guided by governmental and political jurisdictions, which are responsible for issuing permits. Jurisdictional agencies within the study area include:

- Pima Association of Governments
- Pima County Department of Transportation
- City of Tucson Department of Transportation

## 4.13.4 References

Pima Association of Governments

2001 2001-2025 Regional Transportation Plan.

Regional Transportation Improvement Program FY 2002 through FY 2006.

1995-2000 Regional Transportation System Performance Assessment.

Pima Association of Governments website. www.pagnet.org.

Pima County Department of Transportation

Pima County Department of Transportation website. www.dot.co.pima.az.us.

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# 4.14 Safety

## 4.14.1 Introduction

This section describes the existing environmental conditions in the study area relating to public health and safety, such as wastes and flooding. Hazardous, toxic, and radioactive waste (HTRW) is briefly mentioned here; however, it is discussed in greater detail in Section 4.10, Hazardous and Toxic Waste Material.

## 4.14.2 Environmental Setting

Environmental conditions that may affect public health and safety in the vicinity of the study area are solid waste and landfills, wastewater, stormwater runoff, floods, geologic subsidence, and hazardous waste. Hazardous, toxic, and radioactive waste (HTRW) is discussed in Section 4.10.

### 4.14.2.1 Landfills

In Pima County there are approximately 33 old and active landfills, many of which are near watercourses. There are four closed landfills along the Rillito River in the vicinity of the study area, the Columbus 1 and 2 Landfills, the Walnut Landfill, and the Cactus Landfill. These landfills began as sand and gravel operations, and then were active and operated by the City of Tucson from approximately 1960 to 1980. Studies indicate that there is little evidence of local groundwater contamination from the Columbus and Walnut Landfills; however, further studies are required for additional monitoring wells and further sampling to better define groundwater quality conditions and thus establish the potential for future groundwater contamination from the closed landfills. Studies also indicate that further soil gas monitoring is needed to evaluate the long-term impact of methane at the Walnut Landfill.

An active landfill of particular concern is located along the Pantano Wash by Speedway and 22nd Street. This landfill is currently active and although it is not immediately within the study area, has the potential to impact the study area because of its upstream location. Risks from landfills, particularly ones located adjacent to watercourses, comes from the potential for contaminants and other toxic substances to leach to the water table and watercourse, especially during periods of flood events and high flows. Some landfills contain toxic substances while others release methane as the organic matter decomposes.

Another problem with solid waste is illegal "wildcat" dumping. Often, construction debris and other trash items are discarded in washes, rather than a landfill. Trash that

accumulates in watercourses can interfere with flood flows as it moves downstream, particularly if it piles up under bridge structures and restricts flow.

### 4.14.2.2 Wastewater

Treatment of wastewater occurs at three levels: large-scale community wastewater treatments plants, medium-scale subdivision or small community level, and treatment for individual residences with a septic system. Pima County operates two treatment plants along the Santa Cruz River, one at Roger Road, and one at Ina Road. Roger Road Treatment Plant is the closest to the study site, located approximately seven miles to the west. Discharged water from the treatment plant does not occur in the vicinity of the study site, and has no direct impact on the study area, so public health and safety concerns regarding treatment plants are limited.

There are both private and Pima County operated small- and medium-sized water treatment systems, however, they are located west of Interstate 10. Therefore, they are of limited concern in the study area. Septic systems are used in situations where connection to a public wastewater system is not feasible, or where housing density is low. Because the study site is in the metropolitan area of Tucson, and most facilities have readily access to the public sewer system, public health and safety concerns regarding septic systems are limited.

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### 4.14.2.3 Flood History and Flooding Potential

In the Rillito and Santa Cruz Rivers, channelization and erosion control began in the early 1970s as development encroached upon the floodplain of these rivers. Flood and erosion damage occurred during floods of the late 1970s and 1983, which fueled the channelization process. The 1983 flood caused more than 64 million dollars damage to roads, bridges, and public utilities, not to mention private property damage in the Tucson area. By the early to mid 1990s nearly all segments of the Rillito Rivers in the Tucson area had been channelized and stabilized using soil cement or other treatments. As a result of this effort, the January 1993 flood, considered to be similar in magnitude to the 1984 flood in some respects, caused considerably less damage.

In the El Rio Antiguo study area, the Rillito River has been channelized and its banks soil cemented for protection against damage from erosion of flood events. In addition, major washes in the study area, such as Christmas, Alvernon and Alamo, have also been channelized and cemented. In contrast, most washes north of the Rillito in the foothills region remain in a natural state. The Rillito River functions primarily as an urban flood control channel, with soil cement banks. In the foothills region, the Finger Rock Wash and Valley View Wash areas are considered critical basins because of flooding and erosion problems caused by inadequate channels, diverted floodwaters, and homes within

the floodplain. Figure 4.14-1 shows the floodplain zones according to the Federal Emergency Management Agency (FEMA).

A network of flood and precipitation sensors warns of floods coming down the Rillito River system with 13 sensors at Tanque Verde Creed, Sabino Canyon, Agua Caliente, and Ventana Canyon. Pima County has acquired properties in the Riverbend area for floodplain management.

# 4.14.3 Regulatory Setting

## 4.14.3.1 Federal

Federal regulations briefly mentioned below address public health and safety issues regarding hazardous material. Section 4.10, Hazardous and Toxic Waste Material, discusses these regulations in more detail. The U.S. Environmental Protection Agency is the principal federal regulatory agency for hazardous wastes.

## 4.14.3.2 Resource Conservation and Recovery Act (RCRA)

Under this act, hazardous materials are regulated from manufacture to disposal. The law regulates the generation, transportation, treatment, storage, and disposal of hazardous waste at all facilities and sites in the nation.

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## 4.14.3.3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

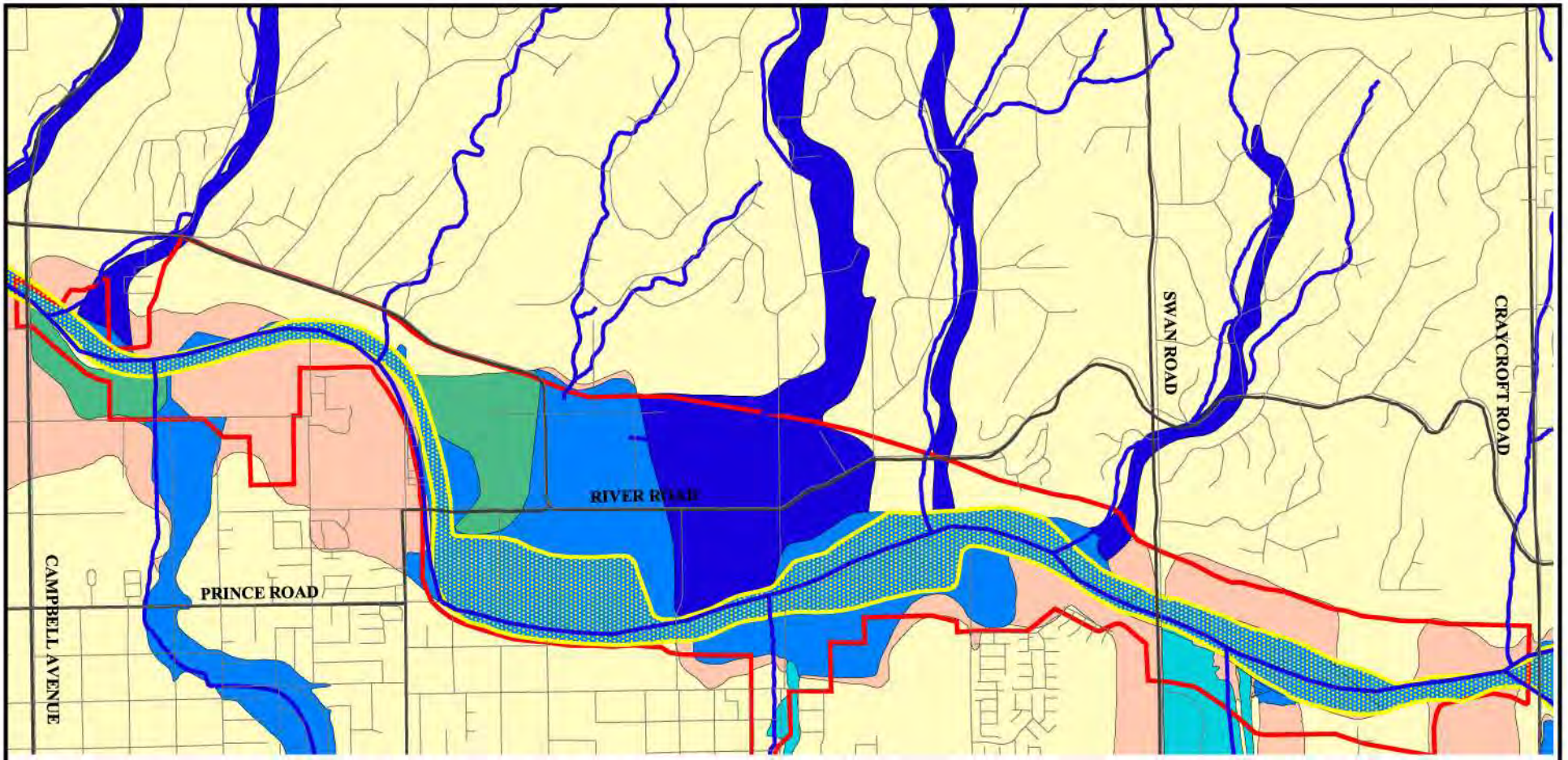
This act, also known as Superfund, was passed to facilitate the cleanup of the nation's toxic waste sites. In 1986, Superfund was amended by the Superfund Amendment and Reauthorization Act (SARA), Title III (community right-to-know laws).

## 4.14.3.4 Occupational Safety and Health Administration (OSHA)

OSHA is the primary federal agency responsible for worker safety in the handling and use of chemicals in the workplace. The employer is required to monitor worker exposure to listed hazardous substances and notify workers of exposure. These regulations specify requirements for employee training, availability of safety equipment, accident-prevention programs, and hazardous substance exposure warnings.

## 4.14.3.5 Federal Emergency Management Agency (FEMA)

FEMA is an independent agency of the federal government. Its mission is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response, and recovery.




**Flood Insurance Rate Zone Descriptions**

Zone A - 100-year floodplains determined by approximate methods - detailed hydraulic analyses are not performed for these areas.
Zone AE - 100-year floodplains determined using detailed methods including hydraulic analyses.
Zone AH - 100-year shallow flooding with a constant water-surface elevation (areas of ponding) where average depths are between 1 and 3 feet.
Zone AO - 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet.
Zone X - outside 100-year floodplain, areas of 100-year sheetflow flooding where average depths are less than 1 foot, areas of 100-year stream-flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees.
Zone X 500-year - areas outside the 100-year floodplain, but within the 500-year floodplain

RECON

Study Area
Major Streets
Minor Streets
Washes
Floodway

0 Mile .4

FEMA Flood Insurance Rate Zone
Zone A
Zone AE
Zone AH
Zone AO
Zone X
Zone X 500-year

# FIGURE 4.14-1
## Federal Emergency Management Agency (FEMA) Floodplain Zones

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### 4.14.3.6 Pima County Floodplain and Erosion Hazard Management Ordinance

This ordinance was developed to conform to the federal government's national flood insurance program. The ordinance includes a series of provisions that regulate the location and construction of buildings and other man-made structures within designated foodplains. The regulations are intended to help maintain the integrity of floodplain areas and to ensure that people and property in flood prone areas are protected from flooding events and flood damages.

## 4.14.4 References

Pima County

2000 An Overview of Pima County's Watersheds and Watercourses. Sonoran Desert Conservation Plan. April.

URS Corporation

2002 HTRW Framework Research Report in support of Feasibility Study for the Proposed El Rio Antiguo Ecosystem Restoration Project. URS Project No. E2-00002096.00. Prepared for U.S. Army Corp of Engineers by URS Corporation, March.

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