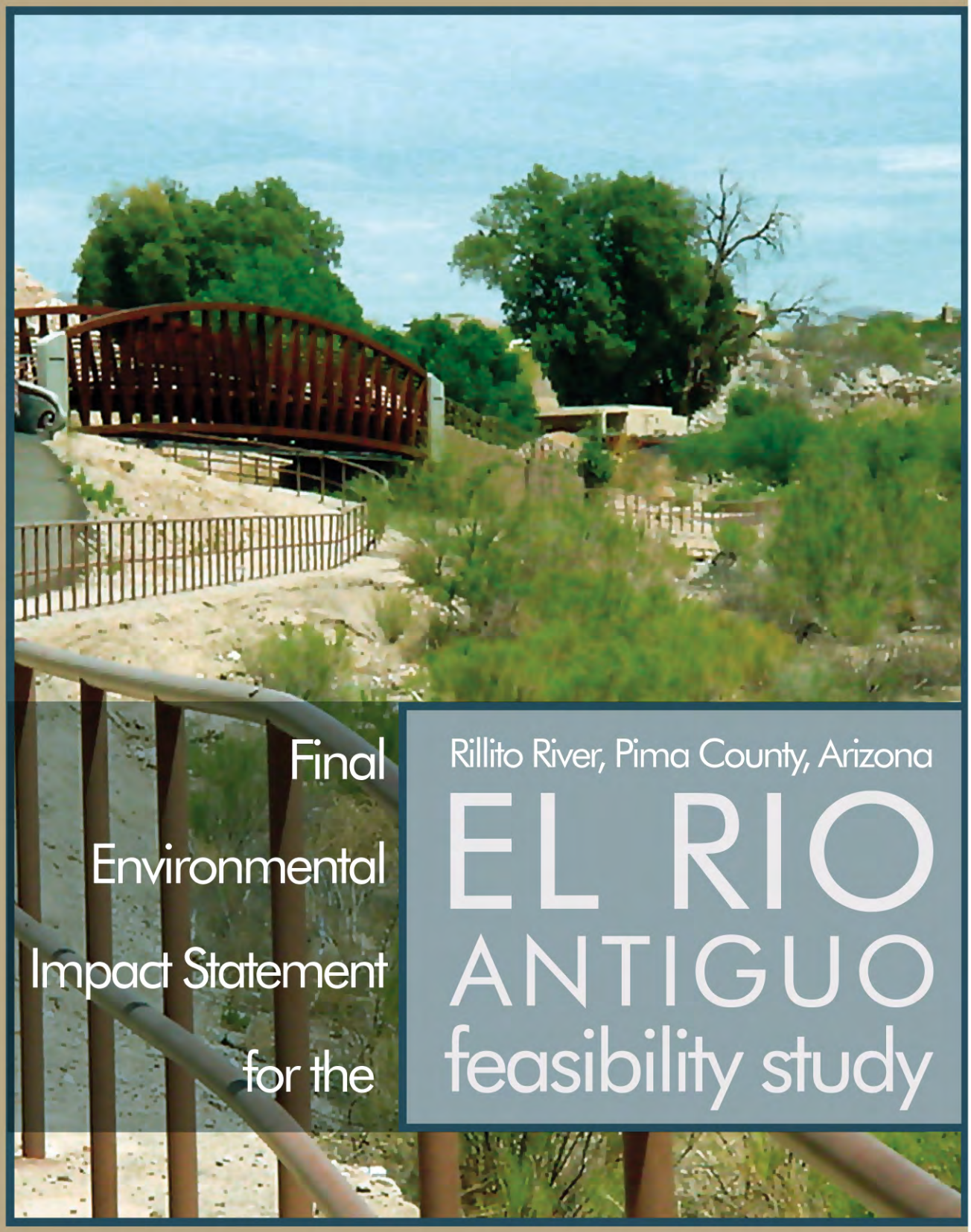

Final

Environmental

Impact Statement

for the

Rillito River, Pima County, Arizona

EL RIO ANTIGUO feasibility study

US Army Corps of Engineers®
Los Angeles District

Prepared for U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053-2325

March 2004

FINAL

ENVIRONMENTAL IMPACT STATEMENT

Rillito River, Pima County, Arizona, El Rio Antiguo

Lead Agency: Department of the Army, U.S. Army Corps of Engineers
Collaborating Agency: Pima County Flood Control and Transportation District
Title of Proposed Action: El Rio Antiguo Feasibility Study
Affected Jurisdictions: Pima County, Arizona
Preparer: Department of the Army, U.S. Army Corps of Engineers

Abstract: The Environmental Impact Statement (EIS) supports the feasibility study by the U.S. Army Corps of Engineers for the Rillito River, Pima County, Arizona, El Rio Antiguo that identifies, defines, and solves environmental degradation, incidental flooding, and related land and water resource problems.

The ecosystem restoration alternatives would utilize the lands within approximately 1,066 acres along 4.8 miles of the existing flood control channel and adjacent areas of undeveloped land in the El Rio Antiguo area and would use available sources of water for restoration of natural habitat areas. The EIS evaluates three action alternatives and compares them to a no action alternative. The final array of alternatives would develop terraces in the areas along the channel, establish rock wash and flood irrigation channels to provide irrigation for new vegetation and establish low flow channels and 12 gabions in the river channel, and develop basins at most of the washes where they join with the Rillito. The terraces would restore the hydrologic functions between the river channel and the terraces and provide mesquite, cottonwood, and scrub/shrub habitat.

Minor short-term impacts are anticipated from removal of existing soil cement banks and grading and construction of project features. Significant beneficial impacts to biological resources are described in the EIS. Important valuable improvements, but incidental, to water quality and recreational resources are also described in the EIS.

Pima County has requested an exemption from effects on water quality during construction as Congressionally authorized in the Clean Water Act, §404(r), and the Arizona Department of Environmental Quality concurs with the 404(r) exemption for the State 401 Water Quality Certification (Attachment A).

EXECUTIVE SUMMARY **S-1**

CHAPTER 1.0 – INTRODUCTION **1**

1.1 Study Location 1

1.2 Purpose and Scope of the Environmental Impact Statement 3

1.3 Technical and Environmental Reports Preceding this EIS 4

1.4 Background and History of Project Alternatives 7

1.5 Compliance with National Environmental Policy Act 9

1.6 Agency Coordination 9

1.7 Extra-Jurisdictional Possibilities Centered on the Rillito River 11

CHAPTER 2.0 – RATIONALE AND PLANNING OBJECTIVES **12**

2.1 Study Authority 12

2.2 Need for the Project 12

2.3 Planning Objectives 13

2.4 Public Participation 13

CHAPTER 3.0 – ALTERNATIVES **19**

3.1 Background and Introduction 19

3.2 Alternatives 23

3.3 Twenty Alternatives Selected for Evaluation 54

3.4 Sorting Out the Alternative Evaluations 57

3.5 Presentation of Alternatives 59

3.6 The Recommended Plan 60

3.7 Summary 64

CHAPTER 4.0 - AFFECTED ENVIRONMENT **66**

4.1 Introduction and Physical Setting of the Rillito River and Study Area 66

4.2 Quantifying Ecological Processes and Biological Resources 70

4.3 Topography and Geology 77

4.4 Hydrology/Water Resources 78
4.5 Biological Resources 86
4.6 Land Use 123
4.7 Aesthetic Resources 130
4.8 Recreation Resources 132
4.9 Air Quality 142
4.10 Noise 144
4.11 Cultural Resources 145
4.12 Hazardous and Toxic Waste 156
4.13 Socioeconomics 157
4.14 Utilities 158
4.15 Transportation 159
4.16 Safety 161

CHAPTER 5.0 - ENVIRONMENTAL CONSEQUENCES 163

5.1 Topography and Geology 163
5.2 Hydrology/Water Resources 173
5.3 Biological Resources 178
5.4 Land Use 186
5.5 Aesthetic Resources 188
5.6 Recreation Resources 190
5.7 Air Quality 193
5.8 Noise 195
5.9 Cultural Resources 197
5.10 Hazardous and Toxic Waste 200
5.11 Socioeconomics 201
5.12 Utilities 202
5.13 Transportation 203
5.14 Safety 205

CHAPTER 6.0 - COMPLIANCE WITH APPLICABLE FEDERAL AND ARIZONA STATUTES **206**

CHAPTER 7.0 - CUMULATIVE IMPACT ANALYSIS **216**

7.1 Topics Without Cumulative Effects 216

7.2 Water Resources 218

7.3 Biological Resources 218

7.4 Irretrievable or Irreversible Commitments of Resources 219

CHAPTER 8.0 – LIST OF PREPARERS **221**

CHAPTER 9.0 - DISTRIBUTION LIST **222**

CHAPTER 10.0 – INDEX **228**

FIGURES

1-1: General Location of Pima County and El Rio Antiguo Study Area 2
3-1: El Rio Antiguo Potential Restoration Configuration 22
3-2: Measures Considered in the Alternatives 24
3-3: Water Harvesting Basin 29
3-4: Historic Aerial Photo of the Rillito River 33
3-5: Typical High and Low Flow Channels 37
3-6: Terraces Design in the Bend 40
3-7: Inflatable Barrier (Rubber Dam) 45
3-8: Reclaimed Water Lines 51
3-9: Alternative 2e: 2 Terraces with Gabions with New Buffer 61
3-10: Alternative 2f: 2 Terraces with Gabions without New Buffer 62
3-11: Alternative 2h: 1 Terrace with Gabions without New Buffer 63
3-12: Conceptual Future Conditions with Recommended Plan 65
4.5-1: Aerial Photograph of the El Rio Antiguo Study Area and Rillito/ Swan Wetlands 87
4.5-2: Soils within the El Rio Antiguo Study Area 93
4.5-3: Vegetation Communities, Overview 95
4.5-3a: Vegetation Communities 96
4.5-3b: Vegetation Communities 97
4.5-3c: Vegetation Communities 98
4.5-3d: Vegetation Communities 99
4.5-4: Historical Occurrences of Sensitive Species Adjacent to El Rio Antiguo Study Area 117
4.6-1: Land Use Designations 125
4.8-1: Recreation Resources 134

TABLES

3-1: Alternatives Matrix 55
3-2: Alternative and Measures Matrix 56
4.2-1: Description of Existing Conditions, in Terms of Ecological Processes, and Ecosystem Restoration Goals 74
4.4-1: Water Quality Samples with Constituent Concentrations of Potential Health Concern 80
4.4-2: Rillito River near Tucson, Peak Discharge-Frequency Values 82
4.4-3: Peak Discharge Flows for Storms and Floods of Record 83
4.5-1: Vegetation Communities 94
4.5-2: Plant Species Observed within the El Rio Antiguo Study Area 100
4.5-3: Wildlife Species Detected on the El Rio Antiguo Study Area 106
4.5-4: Sensitive Plant and Wildlife Species Known or with Potential to Occur in the El Rio Antiguo Study Area 108
4.5-5: Species Status Codes 114
4.6-1: Land Use Designations in the El Rio Antiguo Study Area 126
4.8-1: Private and Public Recreational Facilities in El Rio Antiguo Study Area 133
4.8-2: Existing and Future Park Demands 138
4.11-1: Chronological Cultural Overview of the Tucson Basin 150
5-1: Review of Potential Impacts 164
5-2: Summary Comparison of Alternatives 167
5.2-1: Numerical Results for Ecosystem Functional Assessment of Ecosystem Restoration Alternatives on Ecological Processes Important to the Project 174
5.3-1: Numeric Results from Ecosystem Functional Assessment Model of Ecological Processes Examined For Each Restoration Alternative; 2E, 2F, and 2H 181
5.7-1: Estimated Total Emissions With Implementation of Either One of the Three Restoration Alternatives 193
6-1: Conformity with Environmental Statutes and Regulations by Three Alternatives Proposed for Ecosystem Restoration and Analyzed in this EIS for El Rio Antiguo Feasibility Study 207
7.1-1: Topics of the Human Environment Found to Lack Adverse Causal Impacts, by Analyses Presented in Chapter 5 216

PHOTOGRAPHS

4.5-1: Sonoran Deciduous Swamp and Riparian Scrubland Community West of Swan Road 104
4.5-2: Representative Sonoran Interior Strand Community within the Rillito River 104

ATTACHMENTS

A: Pursuant to Clean Water Act of 1972, § 404, 404 (b) (1) Evaluation of Effects on Waters of the United States
B: Letters of Coordination with U.S. Fish and Wildlife Service
C: Comments and Responses on the Draft Environmental Impact Statement
D: Species Accounts
E: Recreation Facilities within the Pima County/Tucson Metropolitan Area

Executive Summary

Introduction

This Environmental Impact Statement (EIS) has been prepared in accordance with Army Regulation ER 200-2-2 and the Council on Environmental Quality (CEQ) regulations (40 CFR §1502.9) implementing the National Environmental Policy Act (NEPA).

Content of EIS and Supporting Documentation

The EIS covers the Feasibility Study by the U.S. Army Corps of Engineers of the Rillito River, Pima County, Arizona, in the area known locally as El Rio Antiguo to identify, define, and solve environmental degradation and related land and water resource problems. Detailed information concerning the development and evaluation of alternatives and plan formulation and background information are contained in the main feasibility report and appendixes. The EIS summarizes those portions of the feasibility report necessary to describe the impacts of the alternatives on the human environment and incorporates the detailed supporting information by reference.

Background

The El Rio Antiguo reach of the Rillito River, which is the study area, consists of that portion of the river extending from Craycroft Road at upstream end down to Campbell Avenue. The feasibility study efforts are proceeding in partnership with Pima County Flood Control, the non-federal sponsor. The study area covers an area approximately 4.8 miles long, varying from one mile to one-quarter mile wide, and encompassing approximately 1,066 acres. The Rillito River (also known as Creek) flows from east to west across the northern boundary of the city of Tucson from the confluence of Tanque Verde Creek and Pantano Wash to the Santa Cruz River 7.2 miles away.

The study area was provided flood protection by a previous project that included soil cement channel slopes and grade control structures in the channel. Although flood damages continue to occur in some portions of the study area, the primary problem is the severe degradation and loss of riparian habitat along the Rillito River since the early twentieth century.

Water once flowed perennially in the area and supported substantial growth of cottonwoods, willows, and mesquites. Increasing appropriation of surface and ground

water to support expansion of agriculture and growing urban populations resulted in the transformation of the Rillito from a river with perennial surface and subsurface flows to a dry wash with stabilized banks that flows only ephemerally in response to storm runoff. As a result of this change, stands of native riparian habitat are rare in the study area.

This type of river-connected riparian and fringe habitat is of an extremely high value due to its rarity. Arid Southwest riparian ecosystems are designated as a critically endangered habitat type. It has been estimated that 75 to 90 percent of all wildlife in the arid southwest is riparian dependent during some part of its life cycle. As a direct consequence of the extent of the lost or degraded riparian habitat, the area has experienced a major reduction in species diversity and in the population of remaining species.

In addition, destruction of native riparian habitat facilitates an increase in invasive plant species that are more tolerant of disturbed conditions. Such plants consume more water than native vegetation, placing additional strains on limited water supplies

Development of Alternatives

The restoration alternatives would utilize the lands within the existing flood control channel and adjacent areas of undeveloped land in the El Rio Antiguo area and available sources of water for restoration of natural habitat areas. Restoration alternatives have the potential to increase riparian habitat acreage and quality and thereby expand wildlife diversity and quantity, control invasive plant species, and provide an ecological resource that is significant and valuable in the region.

The federal planning objective for ecosystem restoration studies is to contribute to National Ecosystem Restoration (NER) through increasing the net quality and/or quantity of desired ecosystem resources. The specific objectives for environmental restoration within the study area have been identified as follows:

- Restore riparian vegetative communities within the river corridor to a more natural state.
- Increase the acreage of functional seasonal wetland habitat within the study area.
- Increase habitat diversity by providing a mix of habitats within the river corridor including the riparian fringe and buffer.
- Provide incidental flood control through ecosystem restoration to the extent that it does not impact the restoration object.

- Increase recreation and environmental education opportunities within the study area.

The feasibility study identified problems and needs as well as opportunities and constraints. Alternative plans were developed to improve and increase habitat values and diversify wildlife species as well as provide recreation and environmental education with potential incidental benefits associated with flood damage reduction, water quality, and supply. As the study continued, the set of measures was screened and refined.

The study team used a six-step planning process to develop, evaluate, and compare the array of candidate plans that have been considered. Steps in the plan formulation process include:

1. The specific problems and opportunities to be addressed in the study were identified, and the causes of the problems were discussed and documented. Planning goals were set, objectives were established, and constraints were identified.

2. Existing and future without-project conditions were identified, analyzed, and forecast. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation were characterized and documented.

3. The study team formulated alternative plans that address the planning objectives. An initial set of alternatives was developed and will be evaluated at a preliminary level of detail.

4. Alternative project plans were evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans were evaluated using the system of accounts framework (NED, EQ, RED, OSE) specified in the Principles and Guidelines and ER 1105-2-100.

5. Alternative plans were compared. The public involvement program was used to obtain public input to the alternative identification and evaluation process. Cost effectiveness and incremental cost analysis were used to prioritize and rank ecosystem restoration alternatives. A benefit cost analysis was conducted to prioritize and rank recreational measures.

6. A plan was tentatively proposed for selection, and a justification for plan selection was based upon two customary forms of cost assessment: Cost Effective Analysis and Incremental Cost Analysis.

Coordination During Plan Formulation and Alternative Development

Formal and informal coordination occurred with a variety of federal, state, and local agencies in addition to the public involvement efforts described above. Agencies contacted included the United States Fish and Wildlife Service, the Arizona Game and Fish Department, City of Tucson Parks, Tucson Water Department, City of Tucson Transportation, Pima County Department of Transportation, Pima County Cultural Resources, and Pima County Parks and Recreation. In addition to the above, local stakeholders included the University of Arizona Cooperative Extension, Pima Trails, local homeowners associations, and Tucson Audubon Society.

Environmental analyses conducted in accordance with the provisions of the National Environmental Protection Act indicate the likelihood of no lasting negative impacts from implementation of the recommended plan. The analyses identified a number of short-term impacts associated with construction activities and concluded that these impacts could be mitigated through implementation of Best Management Practices designed to reduce or eliminate those impacts.

The non-federal sponsor, Pima County Flood Control, has also expressed a desire to increase the passive recreation opportunities incidental to the restoration effort within the study area.

The Draft EIS was made available for review and comment as part of the NEPA process, along with the Feasibility Study and appendices. A public meeting was held on January 28, 2004, at Green Fields Country Day School in Tucson. For details, please see Appendix J to the Feasibility Study, which describes public involvement.

Alternatives Evaluated in EIS

No Action

The Corps of Engineers must consider the option of undertaking no action of any form as one of the alternatives necessary for compliance with NEPA. “No Action” constitutes a possible decision to implement no ecosystem restoration by the Corps at the Rillito River. Electing to take no action in the present becomes synonymous with the expectation of future conditions without the proposed project. This future projection of conditions forms the basis of comparison with and similar projection of all other alternative plans.

The no action alternative assumes that future development would occur in accordance with currently adopted plans including the City of Tucson General Plan, the Pima County Comprehensive Plan Update, and the Sonoran Desert Conservation Plan.

Final Array of Action Alternatives

The final array of alternatives, Alternatives 2E, 2F, and 2H described in detail in Chapter 3 of the EIS and in the main feasibility report, would consist of implementing terraces in the bend area, Finger Rock Wash high and low flow channels in the bend area, 12 gabions in the river channel, and basins at most of the washes where they join with the Rillito. The terraces would restore the hydrologic functions between the river channel and the terraces and provide mesquite, cottonwood, and scrub/shrub habitat. The Finger Rock Wash high and low flow channels would guide water to the Rillito and provide water to the terraces, as well as provide mesquite and some scrub/shrub habitat. The gabions would facilitate and protect the establishment of vegetation, including scrub/shrub and cottonwood willow, in the river channel. The gabions would improve the hydrologic functions by directing low flow and creating shallow backwater areas where vegetation communities would flourish. The basins would functions to slow and capture the water from the washes after periods of rains. They would provide valuable cottonwood willow and mesquite habitat and improve important chemical and hydrologic functions such as increasing water absorption and nutrient cycling and water filtration. Together, all these measures combine to maximize the hydrologic functions, improving infiltration and water availability for vegetation communities that are critical to native wildlife.

The alternatives vary by inclusion of a single terrace about 32 acres in size or paired terraces about 43 acres in combined size at the Bend and the extent of effort taken to preserve existing buffer area or add to the inventory of the buffer areas throughout the study area.

Alternative 2E: 2 Terraces with Gabions with New Buffer

The 2 Terraces with Gabions 4 alternative includes two sets of tiered terraces in the bend area. Mesquite, cottonwood willow, and scrub/shrub vegetation communities would be planted on the terraces. The high and low flow channels in the bend area would function to capture flows from Finger Rock Wash and distribute water to the terraces. The eight upstream basins would be constructed under this alternative. In-channel restoration efforts include the construction and placement of 12 gabions in the river channel to protect existing vegetation as well as encourage revegetation of sandbars.

For this alternative, existing buffer areas would be restored and improved with native plantings, and new buffer areas would be created.

Alternative 2F: 2 Terraces with Gabions without New Buffer

Alternative 2F is the same as Alternative 2E, 2 Terraces with Gabions 4, except that no existing buffer areas would be improved and no new buffer areas would be created.

Alternative 2H: 1 Terrace with Gabions without New Buffer (tentatively the recommended plan)

This alternative includes one set of tiered terraces in the bend area, approximately 4,300 feet in length. The three levels of the terrace would have mesquite, cottonwood willow, and scrub/shrub vegetation communities. This alternative includes the high and low flow channels that would capture flows from Ringer Rock Wash and distribute the water to the terraces. This alternative includes the eight upstream basins. This alternative includes channel restoration measures. The 12 gabions would be placed in the river channel to protect vegetation communities and encourage revegetation.

Cottonwood willow forest and scrub/shrub communities would be restored in the channel, primarily in the upstream area of the study site where the groundwater level is higher. No new buffer areas would be created and no existing buffer areas would be improved.

Alternative 2H is expected to increase all ecosystem functions assessed to a moderate to excellent function except protective buffer. The protective buffer function is expected to decrease in both the without project and with project condition from a high to a moderate level of function. Specific plan features are described below.

Three levels of terraces would be developed by removing portions of the soil cement banks and grading the areas along the channels. The first terrace will be cut into existing soil cement beginning at the flow height of the 5-year flow. A second level of the terrace will be at the height of a 10-year flow, and a third level will be at a 20-year flow. Terraces will be irrigated with flood irrigation using reclaimed water (treated to secondary standards) and will receive overflows from the Finger Rock Wash and the Rillito River. Overflows from Finger Rock Wash low flow channel will be directed across the bend park through “Mormon” style ditches and then through a graded system of berms and swales through the various plantings.

The bridge at Dodge Road will be removed as a part of this ecosystem terrace measure after construction of Alvernon Bridge. This will discourage vehicle traffic or recreation through the restoration features and improve the hydraulic regime by removing a constriction in the bend area.

Terracing in combination with flood irrigation and provisions for flooding from Finger Rock Wash across this area will reconnect the channel with its floodplain in this area. Terracing and the berm and swale grading plan will improve surface water storage and dynamic energy dissipation by improving microtopographic relief and increasing coarse woody debris. It will also dissipate more flood energy through the widened channel and increased vegetation. While the perennial flow is not restored, increased frequency of inundation from irrigation and water harvesting of tributary flows should increase soil

moisture. Increased vegetation density and coarse wood debris should slow flood flows and allow for increased soil moisture and plant intake. Subsurface water storage will be improved as irrigation and directed flood flows will increase soil moisture, thus decreasing depth to saturated sediments for plant maintenance.

Terracing will also improve biogeochemical functions as increased vegetation densities at this location will provide more classes of decay, coarse and fine woody debris percentages should increase, and there should be an increase in percentage of litter cover. Surface and subsurface flows will be increased as well as potential for development of sediment layers creating restrictive soil lenses that will retain moisture. Habitat functionality will be increased by terracing as it will allow plants to use Rillito and Finger Rock flood flows as a water source and will permit increased access of terrestrial and aerial wildlife to a more contiguous area of food and cover.

Eight basins for water harvesting will be excavated at tributary confluences with the Rillito and contoured with swales, berms, and vegetative gabions used to distribute water from tributary flows to plant communities.

The tributary streambeds will be planted with cienega marsh vegetation up to the width of the natural channel and with mesquite or cottonwood communities. Basins will be sited to avoid impacts to and potentially offer protection for cultural resources. Plant communities will be supported by flood irrigation for establishment and to alleviate drought conditions if they occur.

Water harvesting basins will improve the function of the ecosystem hydrologically, biogeochemically, and biologically in several ways. The basins will reduce annual operation and maintenance costs by reducing the volumes of reclaimed water needed for irrigation. They increase hydrogeomorphic function by slowing and retaining flows within the system for longer periods, increasing retention of potential woody debris inputs, increasing the flood-prone area, and increasing microtopographical relief.

The proposed Craycroft to Swan Pipe and Ditch Irrigation System would allow flood flows from the Rillito and from small foothill basins to be used in the lower elevation areas behind the soil cement between Craycroft Road and Swan Road on the north bank of the river. A culvert and pipe system will be constructed through the soil cement at the 2-year-event flow level. Using gravity pressure through the pipe, the water will flow into a one-foot-deep ditch and then be allowed to overflow through a system of berms and swales across the proposed restoration areas of cottonwood willow forest and mesquite bosque. Excessive flows will drain through the existing culvert under Swan Road and out into the Rillito at the confluence with Flecha Caida Wash.

Finger Rock Wash channels would be developed. These would consist of a low flow channel stabilized with a Reno mattress and vegetation.

The high flow channel has an effective flow without a second larger channel to convey flows between the 10- and 100-year flow. This channel will also be stabilized with a Reno mattress and vegetation (primarily mesquite community).

Additional Water Sources

Reclaimed water accessed from existing reclaimed waterlines as shown on mapping will be distributed through an irrigation system in all restored areas. This system will use flood irrigation (most commonly seen in agricultural settings) and direct the water through the plants using a system of swales and berms. The cultural landscape will be maintained by using Mormon ditch style irrigation.

Flood flows beginning with the two-year event will be directed behind the soil cement below Craycroft through a pipe and ditch system stabilized with vegetation. This system will inundate the existing and restored vegetation between Craycroft and Swan Roads.

Plant Communities

Each plant community will be planted at a high density with the expectation of some die-off. It is expected that the stronger plants will survive in a more natural configuration than could be designed for the original planting scheme. Each community and the river bottom will be seeded with native grasses to encourage cienega development. A grading plan will be developed that will allow irrigated flows to reach the planted area, mimicking naturally occurring low flow events. Plant communities will increase all ecosystem functions assessed for this study. They will increase hydrogeomorphic function by slowing flows and increasing the amount of time water is retained within the system, allowing for a more sustainable habitat. This will also reduce depth to saturated sediment, increase organic matter contribution for nutrients, increase litter and woody debris, increase flow frequency through flood irrigation, and increase species diversity and biomass. This is expected to increase use of the area by wildlife and the use of this corridor as a connection between other habitats. Tree, shrub, and herb canopies will increase, creating greater structural diversity within each plant community.

Mesquite Communities: Mesquite bosque communities will include mesquite, desert willow, blue palo verde, wolfberry, graythorn, and hackberry. It will be approximately 115.9 total acres across the project area with an expected water use of 4.0 acre-feet of water per year per acre. Plantings will be done at a high density with the expectation of some die-out. Two hundred forty 5-gallon shrubs per acre will be planted along with seventy 15-gallon trees per acre and the area will be seeded with native grasses.

Cottonwood-Willow Forest Communities: Cottonwood and willow communities will include Fremont cottonwood, Goodding's willow, sycamore, ash, Arizona walnut, and hackberry. Approximately 98.9 acres will be planted in this community type with an expected water need of 8.5 acre-feet of water per year per acre. Eighty-five 15-gallon

trees will be planted per acre, and 250 shrubs in five-gallon containers will be planted per acre.

Desert Wash (Scrub/Shrub) Communities: Sixty-two acres of desert wash or strand communities in the river bottom and tributaries will be planted and maintained. Plant communities will include wolfberry, graythorn, hackberry, seep willow, bursage, and saltbush. Water needs are expected to be 3.0 acre-feet of water per year per acre. Plantings will use five-gallon container plants.

Cienega (River bottom): Over seven acres of cienega grasses will be planted with native grasses at tributary mouths. The rest of the river bottom will be seeded with native grasses. These areas will not be irrigated. They are expected to survive on ancillary water from irrigation of other plantings and natural flows.

The high and low flow channels contribute to improvement of riverine function by reconnecting the tributary to the river, creating a potential wildlife corridor and habitat for wildlife, increasing macro- and microtopographic relief, directing tributary flows into habitat, and creating potential for a vital wildlife corridor between the Santa Catalinas and the Tucson Basin.

Real Estate Plan

A real estate plan has been developed and is included in Appendix I of the Feasibility Report. A real estate cost estimate has been prepared for Alternative 2H and has been used in the MCACES analysis provided in the Cost Appendix.

Recreation Plan

A Recreation Plan has been developed and is discussed in the Economic and Cost Estimating Appendices of the Feasibility Report. A cost estimate for the six primary components of the Recreation Plan has been prepared for Alternative 2H and has been used in the MCACES analysis provided in the Cost Appendix. Specific elements of the Recreation Plan include:

1. A single pedestrian bridge
2. Several ramps providing access to the river and a maintenance turnaround area
3. Trail links for multi-purpose trails used for maintenance and recreation
4. Comfort stations
5. Signs/parking
6. Trail widening

Chapter 1.0
Introduction

1.1 Study Location

The focus of this study is the Rillito River, commonly called Rillito Creek, referred to as El Rio Antiguo to distinguish it from previous studies with similar names and also because of its cultural significance. This study encompasses an area approximately 1,066 acres in size located on the uppermost portion of the Rillito River. The Rillito River arises from the confluence of two smaller drainages in eastern Pima County (Figure 1-1): Pantano Wash, which flows northwesterly, and Tanque Verde Wash, which flows roughly due west. Craycroft Road was constructed where these two come together. The study area begins at Craycroft Road. It ends approximately five river miles downstream where Campbell Road was constructed across the Rillito River.

The study area lies north and east of the downtown Tucson area, on the south side of and near the western end of the Santa Catalina Mountains (see Figure 1-1). The formal study area partly hugs the existing south bank of the Rillito River in some areas, but expands elsewhere to encompass other parts of the Rillito's historic floodplain on both the north and the south side (see Figure 1-1). The Rillito flows through a predominantly residential region on the north side of Tucson. Some residential sections are densely inhabited, especially on the river's south bank, while other residential tracts are more spacious and rural in character, especially on the river's north bank.

The northern side of the study area follows roughly the line formed where alluvial deposits from the Santa Catalinas spread out below the lowest of the foothills. Thus, the north side of the study area is alluvial in overall character. On the south side, the study boundary follows the river's bank in some areas, the mouth of desert washes in other areas, and boundaries of properties owned by Pima County Flood Control and Transportation District (PCFCTD) in still other places.

An irregularly shaped parcel located along the Rillito's south bank is currently the focus of plans by the U.S. Army Corps of Engineers (USACE or Corps) and Pima County for environmental restoration. This project would extend from the north end of Columbus

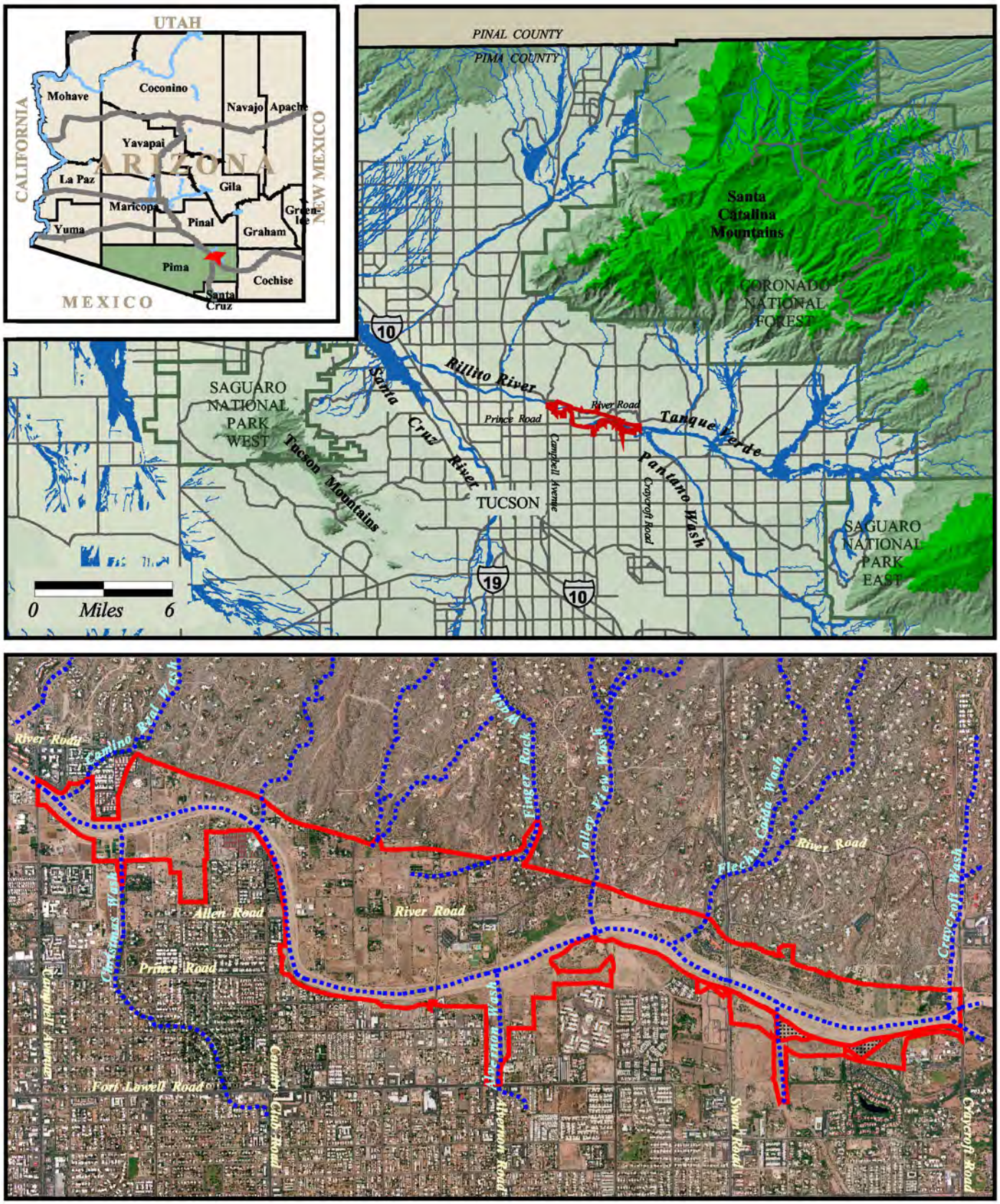

FIGURE 1-1

General Location of Pima County and El Rio Antiguo Study Area

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Avenue at its downstream end to Craycroft Boulevard at its upstream terminus. If authorized as the Rillito River 1135 Ecosystem Restoration Project, trees, shrubs, and herbaceous vegetation native to the Sonoran Desert would be reestablished in an area about 61 acres in size, and any and all environmental benefits realized by this separate project would be accounted completely apart from and independent of El Rio Antiguo. In effect, the proposed Rillito River 1135 project precludes all other environmental planning. Most of its area, approximately 55 acres out of the total, is centered at Columbus Avenue (see Figure 1-1). All of it will be treated as a void inside the boundaries of the present study.

1.2 Purpose and Scope of the Environmental Impact Statement

The project described and evaluated in this EIS would partially restore lost ecosystem characteristics that were once hallmarks of the riparian ecosystem in this region of the Sonoran Desert. The project would bring back riparian plant life where existing conditions of the Rillito River allow. If implemented, this project would mimic the fundamental physical and biotic conditions that foster the growth, maturation, and reproduction of the numerous plant species adapted to rivers and their environs in the Sonoran Desert. By restoring a goodly portion of the ecologically diverse plants which belong here, a parallel array of diverse animal species would also thrive on the fruits of ecosystem restoration.

Actually, the purpose of this project may reasonably be viewed in two related ways. In a rather narrow sense, the biological communities found along the Rillito River a century and more ago have all but vanished. In the same narrow sense, this project would restore to some portions of the Rillito the root conditions biological communities adapted to the Sonoran Desert must have to survive and mature. Steady disappearance of these kinds of communities, both the plant life and various animal life entirely dependent on those plants, has come to be seen as a substantial loss in the quality of the human environment. Implementation of the project would restore seasonal wetlands, riparian gallery forest, and mesquite thickets.

In a broad sense meant to encompass the several rivers once verdant and perennial throughout this region of the Sonoran Desert, the ecosystem these rivers comprised is now severely stunted. In similar broad purpose, this project would make physical changes to the Rillito's bed, to the places where washes join it from both sides, and to its banks and the land a bit beyond them in the Bend area to restore fundamental conditions, which govern how ecosystems themselves survive and mature. Steady realization of the profound effects human enterprises have on the health of ecosystems, effects commonly judged adverse, has also come to be seen as a substantial loss in the quality of the human

environment. Implementation of the project would restore the ecological processes plants and animals of the Sonoran Desert need in order to prosper.

Ecological integrity, quality, and simple acreage of riparian ecosystems have each diminished very substantially in the arid southwest. Ecosystem restoration on this portion of the Rillito would contribute modestly to the National Ecosystem Restoration (NER) inventory by increasing the net quality and/or quantity of desired ecosystem resources. As a result, the project makes use of a limited area to restore riparian vegetative communities within the river corridor to a more natural state; increase the acreage of functional seasonal wetland habitat within the study area; increase the acreage of cottonwood and willow habitat within the study area; increase the acreage of mesquite woodlands within the study area; increase habitat diversity by providing a mix of habitats within the river corridor including the riparian fringe, some overbank areas, and buffer; provide incidental flood control through ecosystem restoration to the extent that it does not impact the restoration object; and increase recreation and environmental education opportunities within the study area.

The EIS would describe existing conditions, expectations of how those conditions would appear in the year 2058 in the absence of any project, and expectations of how circumstances would change as a result of implementing alternatives. These evaluations focus on:

- Topography and geology
- Hydrology and water resources
- Biological resources
- Land use
- Aesthetics
- Recreation
- Air quality
- Noise
- Cultural resources
- Hazardous and toxic waste materials
- Socioeconomics
- Utilities
- Traffic and transportation
- Safety

1.3 Technical and Environmental Reports Preceding This EIS

The following section is a compilation of reports, studies, projects, and community plans that may be pertinent to this study.

1.3.1 Existing USACE Reports

a. Gila River, Santa Cruz River Watershed, Pima County, Arizona, Preliminary Draft Feasibility (F4) Report, U.S. Army Corps of Engineers, December 2000.

b. Gila River and Tributaries, Arizona and New Mexico, Santa Cruz River Watershed Basin Final Reconnaissance Study, Arizona. Los Angeles District, Corps of Engineers, 1996.

c. Gila River and Tributaries, Arizona and New Mexico, Design Memorandum Rillito River, Tucson, Arizona Bank Protection. Los Angeles District, Corps of Engineers, 1992.

d. Survey Report & Environmental Assessment, Rillito River & Associated Streams, Tucson, Arizona, U.S. Army Corps of Engineers, May 1986, revised 2/13/87.

e. Lower Finger Rock Wash, Tucson, Pima County, Arizona, Detailed Project Report Section 205, Los Angeles District, Corps of Engineers, September 1996. Lower Finger Rock Wash is a tributary of the Rillito River, which flows into the Bend area of the river.

f. U.S. Army Corps of Engineers, Design Memorandum, Rillito River, Tucson, Arizona, Bank Protection: U.S. Army Corps of Engineers, Los Angeles District, October 1992.

g. General Design Memorandum for: The Rillito River Bank Protection, Campbell Avenue to Country Club Road: A Technical Services Report Prepared by the Flood Control Design Section for the U.S. Army Corps of Engineers, Los Angeles District, August 1991.

1.3.2 Prior Studies and Reports by Other Agencies

a. Fonseca, J. and W. Melgin. 1996. Rillito Recharge Project. High Plains States Ground Water Demonstration Program U.S. Bureau of Reclamation.

b. U.S. Geological Survey. 1995. Quality of Surface Water and Ground Water in the Proposed Artificial-Recharge Project Area, Rillito Creek Basin, Tucson, Arizona. Water Resources Investigations Report 95–4270:26.

c. U.S. Geological Survey. 1994. Quality of Water and Chemistry of Bottom Sediment in the Rillito Creek Basin, Tucson, Arizona, 1986-92. U.S. Geological Survey Water Resources Investigations Report 94-4114:90.

d. England, A. S. and W. F. Laudenslayer. 1995. The California Desert: An Introduction to Natural Resources and Mans Impact, Volume II. *Birds of the California Desert*, page 337.

e. Camp Dresser & McKee, Inc. 1989. Rillito Creek Recharge Feasibility Study Interim Report Phase A Task 4, Environmental and Archaeological Characterization. Rillito Project Management Committee.

f. Ciolek-Torrello, R. S. and J. A. Homburg. 1990. Cultural Resources Surveys and Overviews of the Rillito River Drainage Area, Pima County, Arizona. Statistical Research Technical Series No. 20.

1.3.3 Existing and Current USACE Studies and Projects

a. Rillito River Section 1135 Ecosystem Restoration Project is currently in development of the Environmental Restoration Report (ERR) and is located on the south bank of the Rillito River within the same study reach. This Section 1135 project reduces the scope of the El Rio Antiguo, Rillito River Restoration Study to the north bank and those areas of the south bank not within the scope of the 1135 project. It was not rolled into this study because it has reached its final study stage with a completed ERR. The study would soon be in the preliminary engineering and design stage. Including it in the scope of the current study effort would seriously delay the completion of the 1135 project.

b. The Gila River and Tributaries, Arizona and New Mexico: Rillito River, Tucson, Arizona Phase II: Bank Protection: Craycroft Road to North Campbell Avenue. Completed.

c. Tierra to Santa Cruz River. The U.S. Army Corps of Engineers was authorized in WRDA 1986 to construct this project for flood control and recreation purposes. Pima County was the local sponsor. The U.S. Army Corps of Engineers completed the Rillito River Bank Protection Project in 1996. With the construction of the Corps of Engineers/Pima County Soil Cement Bank Protection Project, in 1996, the 100-year flood on the Rillito River is contained within the river's banks along most of the study reach.

1.3.4 Community Master Plans

a. Pima County Comprehensive Plan. The purpose of the comprehensive plan is 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. The comprehensive plan includes the following guidelines related to aesthetic resources:

- Restore and preserve natural areas. This may include floodplain acquisition, purchase of development and water rights, and limitations on rezoning.

- Construct wetlands and riparian areas. This may include the use of reclaimed water or CAP water, and recharge projects.

- Preserve open space characteristics of development sensitive lands and promote development that blends with the natural landscape and protects wildlife habitat. Extend visually the public land boundaries.

- Provide natural open space.

b. Sonoran Desert Conservation Plan. In 1998 Pima County Board of Supervisors launched the Sonoran Desert Conservation Plan (SDCP). The goal of the SDCP is to combine short–term actions to protect and enhance the natural environment and long-range planning to ensure that the natural and urban environments not only coexist, but also develop an interdependent relationship where one enhances the other. The SDCP includes the following guidelines related to aesthetic resources:

- Retain mesoriparian and riparian linkage areas (streambed and associated upland) at a minimum of 95 percent of their current level.
- Retain biological core areas at a minimum of 80 percent of their current level.
- Retain biological core areas at a minimum of 80 percent of their current level.
- Retain biological core areas at a minimum of 80 percent of their current level.
- Retain multiple use areas at a minimum of 75 percent of their current level.

1.4 Background and History of Project Alternatives

PCFCTD asked USACE to explore possible remedies for several problems recognized along the Rillito. Many of these problems have long-standing, and regionally widespread, roots but are evident in the immediate region of the study area. In brief, they can be attributed to land use changes in the past 150 years. The Rillito no longer runs as a perennial stream and the average depth to groundwater is far greater than was true in 1850. Without that groundwater, most of the native vegetation and wildlife cannot survive, and the Rillito is biologically quite impoverished. Development of the urban metropolis also caused unwitting degradation of the Rillito and promoted circumstances

under which flooding of its overbanks began to cause economic loss, bank erosion, and lateral migration of the stream bottom. In an effort to stem those types of flooding damages, soil cement bank stabilization has been applied to nearly all parts of the Rillito's banks.

The sponsor wishes to rectify some of these past abuses. Broad aims include:

- increasing native riparian quality for both plants and animals;
- attracting migratory birds into these better habitats;
- gradually creating a continuous biological corridor upstream and downstream in this watershed, and ultimately connecting to the Santa Crus River to the west;
- fostering the reestablishment of species native to the riparian communities and cienegas in the Sonoran Desert, and augmenting overall species diversity;
- creating physical settings in the river bottom itself, where seasonal washes enter it, and in places on the overbank outside of existing soil cement, which promote reestablishment of cienegas, cottonwood willow gallery forests, and mesquite thickets;
- eliminating invasive and non-native plant species;
- restoring vegetative communities within the river corridor to a more natural state; and
- increasing acreage of functional seasonal wetland habitat.

The process of alternative formulation for this study involves successive iterations of alternative solutions. These solutions focus on meeting study objectives and are designed to address the opportunities. Initially, ecosystem restoration measures are considered and evaluated. Those measures selected for further consideration were then combined to form a preliminary set of alternatives. The alternative formulation process involves the continual assessment, evaluation, modification, expanding, combining, elimination, and otherwise shaping of alternatives into a selection of alternatives. These alternative plans are then evaluated for effectiveness, efficiency, completeness, and acceptability. Eventually, the final array of alternative plans are presented in the EIS. Chapter 3, Alternatives, discusses additional details of the alternative formulation process.

1.5 Compliance with National Environmental Policy Act

This document has been prepared to comply with the National Environmental Policy Act (NEPA) to meet the needs of federal, state, and local permitting agencies in considering the proposed restoration of the Rillito River under this study. In addition, other environmental laws, Executive Orders, and relevant policies that have been considered during the preparation of this EIS are detailed in Chapter 6. The lead agency responsible for preparing the EIS for this study is the U.S. Army Corps of Engineers, Los Angeles District. Pima County Flood Control and Transportation Department is the non-federal, local sponsor for this project. The lead agency is responsible for ensuring that this EIS has been prepared in compliance with the provisions of NEPA. The USACE would determine the adequacy and completeness of the Final EIS prior to rendering any decisions on the Proposed Action. The USACE would issue a decision for the Proposed Action in the form of a Record of Decision. The USACE would rely upon the EIS when considering whether to move forward with any of the restoration projects described in the Proposed Action. The EIS would also be utilized by other federal and state agencies to evaluate the project for their permit decisions. The EIS does not make recommendations regarding the approval or denial of the project; it is purely informational in content.

1.6 Agency Coordination

1.6.1 Lead and Cooperating Agencies

The US Army Corps of Engineers is the lead agency for ensuring compliance with the National Environmental Policy Act (NEPA), and all other applicable and relevant laws, rulings, and policies. The restoration alternatives presented in later chapters for decision purposes would partially offset decades of regional urban influences which have led to severe degradation of riparian ecosystems in the Sonoran Desert, and the project therefore conforms with the Corps' explicit environmental mission. The evaluation of the proposed project as required by NEPA has already been cost shared with the local sponsor, Pima County Department of Transportation and Flood Control. If authorized and then implemented, Pima County would continue to share costs of the project's design and construction.

1.6.2 Coordination of Draft and Final Environmental Impact Statement

1.6.2.1 U.S. Fish and Wildlife Service (the Service)

Informal discussions with the Service began in the early summer of 2001. The biologically impoverished conditions of the Rillito River, as it is today, in contrast to the ecologically stable and dynamic conditions found there 150 years ago guided most of these early discussions. Their objective lay in realistically attainable restoration of fundamental ecological processes, not a static picture of trees, shrubs, and animal species which often pass for the ecosystem itself. To that end, the Service has prepared both a Planning Aid Letter and a Coordination Act Report in their capacity as a coordinating agency. Both letters are included (Attachment B).

1.6.2.2 Ecosystem Functional Assessment Procedure (EFA)

The Feasibility Study has a pilot quality about it based on a decision to incorporate ecological processes themselves into all aspects of plan formulation, characterization of existing conditions, and forecasts of project outputs. This has been achieved through use of numerical model derived from hydrogeomorphic functional analyses and adapted to the physical and biological traits of the Rillito River. The EFA grew from an extensive collaboration in which all relevant disciplines—botanists, soils scientists, geologists, fluvial geomorphologists, wildlife ecologists, ecological academicians, urban planners—were represented by numerous different entities. The interdisciplinary team convened to initiate the assessment in November 2001 and included the Service, Arizona Game and Fish Department, Arizona Geological Survey, and knowledgeable expert from the University of Arizona, Arizona State University, and other workgroups from various aspects of the planning process, including the public workshop component, oversight, steering, and technical committees. The team convened in March 2002 to conduct EFA evaluations of reference sites and the Rillito itself. Filed data were collected later in the spring of 2002. In June 2002, the team convened to discuss baseline conditions, their representation in the model, and projects from the model of ecosystem processes in the future without implementation of a project. The team reconvened in August 2002 to refine projections from the model of conditions based on restoration alternatives.

1.6.2.3 Cultural Resources

The Corps has coordinated all matters regarding historic and pre-historic resources with Pima County, Arizona State Historic Preservation Officer (SHPO), and interested Native American nations. In consultation with Pima County and interested Native American tribes, ecosystem restoration measures will be developed in an attempt to avoid impacts to resources eligible for listing in the National Register. If there are any unavoidable impacts and a cultural resource is determined eligible for the National Register,

mitigation will be implemented prior to construction. Mitigation measures will be codified in a memorandum of agreement negotiated with Pima County and interested Native American nations.

A letter will be sent to SHPO with the Corps' 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 SHPO. This includes the draft EIS.

The draft EIS was sent to the following for comment along with all identification, evaluation, and mitigation studies:

Pima County – Ms. Linda Mayro, County Archeologist;
Tohono O'odham Nation – Mr. Peter Steere, Program Manager, Cultural Affairs Department;
Hopi Tribe – Mr. Leigh Kuwanwisiwma, Cultural Preservation Office; and
Pascua Yaqui – Ms. Amalia A. M. Reyes, Language and Culture Preservation Specialist.

1.7 Extra-jurisdictional Possibilities Centered on the Rillito River

The setting and urban circumstances of the Rillito River and most lands immediately bordering it practically invite concepts for extensive and appropriate changes of land use. These would span the gamut from promotion of service oriented commercial enterprises and additional residential development, to efforts aimed at recreation of historical land uses, and undertakings geared more toward ecological features adapted to riverine systems in the Sonoran Desert. Any proposals, which incorporate the existing channel of the Rillito, would be constrained by extant design characteristics. Authorization would be required of the Corps to implement such concepts in the river itself.

Planning objectives might be partially addressed if the need for additional recreational facilities led the City of Tucson or Pima County agencies to develop additional parklands adjacent to the river or on overbanks and available uplands. Planning objectives might also be partially addressed should the Natural Resources Conservation Service be engaged to restore native grasslands on upland areas where lands were available. Finally, planning objectives might also be partially addressed if the U.S. Fish and Wildlife Service were to attempt restoration of mesquite and upland communities in hopes of creating suitable nesting territory for cactus ferruginous pygmy owls, again where available lands could be secured.

None of these potential outcomes suggest an alternative approach to meeting planning objectives that would be outside the Corps jurisdiction. The Corps jurisdiction with respect to environmental restoration and recreation permits it to address any of these opportunities and in an integrated fashion.

Chapter 2.0
Rationale and Planning Objectives

2.1 Study Authority

Congressional directive to pursue feasible means of habitat restoration and development of water resources in Pima County resides in two distinct authorities. An older legislative enactment more specific to water resources in southern Arizona, and more recent legislation in the interest of flood damage reduction, environmental protection and restoration, and related purposes.

The statutory authority for this project investigation and study is contained in the following enacted laws:

Section 6, Public Law 761, Seventy-fifth Congress, dated June 28, 1938, which reads:

> "The Secretary of War is hereby authorized and directed to cause preliminary examination and surveys at the following locations . . . Gila River and Tributaries, Arizona . . . ."

Additional authority was provided by House Resolution 2425, dated March 17, 1994 stating:

> "the Secretary of the Army is hereby requested to review reports as the Chief of Engineers on the State of Arizona . . . in the interest of flood damage reduction, environmental protection and restoration, and related purposes."

Authority for project implementation will be sought in an upcoming Water Resources Development Project as a separately authorized civil works project.

2.2 Need for the Project

Written accounts of Tucson and its environs 150 years ago portray a Rillito River of entirely different character than that seen today. It ran year-round. Gallery forests lined the wetter soils along its banks. Both animal and plant life was more abundant, varied, and widespread along the watercourse.

This feasibility study will address a proposed project offering an opportunity to restore ecologically important riparian and cienega habitats that have been lost in the region due to water resource changes in Pima County. The opportunity exists to use knowledge gained from existing ecosystem restoration projects and utilize other water sources to expand and sustain riparian and cienega habitats along the watercourse.

2.3 Planning Objectives

Federal objectives of water and related land resources planning include contributing to the national economic development (NED) (specifically increases in the net value of the national output of goods and services, expressed on monetary units), and contributing to the National Ecosystem Restoration (NER) through increasing the net quality and/or quantity of ecosystem resources (specifically improvement in habitat quality or quantity typically expressed quantitatively in physical units or indexes). In addition to these overall federal objectives, a number of specific objectives were identified through the planning processes of the project.

The study authority provided the authorization to investigate three purposes for this study: ecosystem restoration, flood control, and recreation. During the feasibility study process, it was determined that it is not necessary for flood control to be a purpose for this study. Hydraulic analysis determined that floodwaters would be contained by the soil cement along the banks of the Rillito, thereby removing the need for flood control to be a purpose in this study.

The overall goal and purpose of this study is ecosystem restoration. Specific planning objectives include:

- restoring riparian vegetative communities to a more natural state;
- increasing in the acreage of functional seasonal wetland habitat, and
- increasing habitat diversity both in the river corridor and along the riparian fringe and buffer.

These objectives were developed through a coordinated effort with the local sponsor, local and regional agencies, the public involvement process, site assessments, review of prior studies and reports, and review of existing water projects.

2.4 Public Participation

2.4.1 Notice of Intent to Prepare an EIS

Formal declaration to the public of the initiation of the feasibility study occurred with publication in the Federal Register of the Notice of Intent. The full text follows.

56660 Federal Register / Vol. 66, No. 218 / Friday, November 9, 2001 / Notices

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent To Prepare a Draft Environmental Impact Statement (DEIS) for *El Rio Antiguo*, Rillito River, a Feasibility Study of a Portion of the Rillito River in the City of Tucson, Pima County, AZ

AGENCY: Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The Los Angeles District of the U.S. Corps of Engineers (the Corps) will initiate analyses of foreseeable environmental impacts from actions potentially to be implemented on a reach of the Rillito River. The Corps will prepare an Environmental Impact Statement (EIS) to accompany the Feasibility Report. Pima County will participate in the Feasibility Study.

The Rillito River flows from east to west along the south face of the Catalina Mountains, and is tributary to the Santa Cruz River. The study area extends from the confluence of Pantano and Tanque Verde Washes, which happens to coincide with Craycroft Road, downstream to Campbell Road. About 4.8 river miles lie between those limits.

Except for a region on the south side approximately one mile long, all existing banks have been stabilized with soils cement. The study area will extend on the north side to include uplands in a region known locally as ''the bend'', and on the south side to encompass lands potentially to be acquired along Alvernon Way and at Campbell Road.

Approximately 925 acres lie within the roughly defined study area, and of that about 525 acres would be called uplands. A habitat restoration project on the south bank of the Rillito (Continuing Authorities Program, section 1135 of the Water Resources Development Act of 1986, as amended) has been initiated within the proposed study area.

Refinements of the study area, both additional inclusions and exclusions, can be expected during the course of the Feasibility Study as appropriate to the general study objectives.

The proposed project emphasizes opportunities to restore riparian habitat, address matters of surface and groundwater quality, explore aquifer recharge along the Rillito, restoration of natural riverbed conditions, fashion localized seasonal wetlands (known in the southwest by the Spanish noun *cienegas*) at opportune places in the river bottom, and create venues appropriate for recreational educational uses of the river. Flood damage reduction on the Rillito itself and washes entering it from foothills of the Catalinas will also constitute aspects of the Feasibility Study.

ADDRESSES: District Engineer, U.S. Army Corps of Engineers, Los Angeles District, ATTN: Dr. John E. Moeur, Regional Planning Section, CESPL–PD–RP, PO Box 532711, Los Angeles, California 90053–2325.

FOR FURTHER INFORMATION CONTACT: Dr. John E. Moeur, Environmental Manager, telephone (213) 452–3874.

SUPPLEMENTARY INFORMATION:

1. Authorization

The Feasibility Study for El Rio Antiguo has two distinct Congressional authorities. The more recent, House Resolution 2425 (dated 17 May 1994), directs: *** the Secretary of the Army *** to review reports of the Chief of Engineers on the State of Arizona *** in the interest of flood damage reduction, environmental protection and restoration, and related purposes.

Congress previously authorized similar endeavors through section 6 of the Flood Control Act of 1938. The 75th Congress of the United States passed what became Public Law 761. This legislation states, in part: *** the Secretary of War [Secretary of the Army since 1947] is hereby authorized and directed to cause preliminary examinations and surveys *** at the following locations: *** Gila River and tributaries, Arizona, ***

2. Background

The Rillito River now appears as a broad dry, wash most of the year. Summer thunderstorms in its watershed may cause it run modestly, or in genuine flood, but it soon reverts to a dry desert wash.

Its environs were much different a century and a half ago. A description written in 1910 portrays it before the Civil War as an unbroken gallery forest along the Rillito dominated by cottonwoods, willows, Arizona ash, Arizona walnut, diverse underbrush species adapted to the Sonoran Desert, interspersed with grasslands of sacaton and big galleta grass. Beavers dammed the Rillito in many places. Where water infiltrated somewhat faster, cienegas formed along the riverbed.

Diversion of surface waters, and then extraction by pumps of water from subsurface strata caused profound regional changes in hydrology starting about the turn of the last century. Thereafter, the Rillito began to decline.

3. Proposed Action

No explicit proposed alternative has yet been identified. The Feasibility Study to be evaluated by this EIS will evaluate impacts of viable alternatives once they have been framed in light of the topography, hydrology, biotic communities, and preferences of the local sponsor. A No action Alternative will form the basis for comparison for these evaluations. The EIS will address at least sixteen diverse kinds of resources important to the Sonoran Desert biome: Aesthetics, agriculture, air quality, biology, cultural, geology, groundwater recharge, hazardous wastes, land use, physical environment, recreation and education, safety, socioeconomic, sound and noise, transportation and communications, and water quality. The public will be afforded ample opportunity to comment on these analyses prior to taking any action to implement any alternative that may then be under consideration.

4. Scoping Process

The Corps will conduct a scooping meeting to aid in determining the importance of pertinent environmental issues. Participation of all interested Federal, State, and County resource agencies, as well as Native American peoples, groups with environmental interests, and all interested individuals is encouraged. Public involvement will be most beneficial and worthwhile in identifying pertinent environmental issues, offering useful information such as published or unpublished data.

Direct personal experience or knowledge which inform decision making, assistance in defining the scope of plans which ought to be considered, and recommending suitable mitigation measures warranted by such plans.

Those wishing to contribute information, ideas, alternatives for actions, and so forth can furnish these contributions in writing to the points of contact indicated above, or by attending public scoping opportunities.

The scoping period will conclude 60 days after publication of this NOI and concurrent publication in newspapers circulated in the greater Tucson area.

5. Public Scoping Meeting

The Corps and the local sponsor invite all interested parties to a public scoping meeting to discuss project goals and offer ideas essential to developing alternatives to achieve those goals. An initial public meeting for the proposed El Rio Antiguo study is scheduled for the evening of Tuesday, November 13, 2001. Please gather at 6 PM in the 1st Evangelical Free Church, located at 4700 N. Swan Road, in Tucson, Arizona.

Individuals, organizations, and agencies who wish to offer information or data relevant to anticipated project objectives, alternatives, impacts, mitigation, or any similar consideration may do so by attending the public scoping meeting. If that means for communication proves infeasible, then kindly mail the information to any of the three addresses noted above.

Luz D. Ortiz, *Army Federal Register Liaison Officer.*
[FR Doc. 01–28244 Filed 11–8–01; 8:45 am]

Billing Code 3710-KF-M

2.4.2 Public Workshop

Pima County Flood Control and Transportation District and the USACE conducted a public workshop during the evening of November 13, 2001. At least 60 people attended and requested their name be added to a permanent mailing list. Written remarks were received from 31 of the people in attendance. For the sake of brevity, the full proceeding may be obtained electronically at no cost or in printed form at the reader's expense from the Corps of Engineers in Los Angeles.

An excerpt from the full transcript, following, conveys the tenor of public interest in the study and the varied points of view of individuals who took the time to participate.

3. Public Input

The attending members of the public were invited to split into two groups on either side of the room. At each meeting area, there were maps of the study area, one showing the study area over an aerial photograph of the area, and another showing the land ownership of parcels in the study area. A representative from the USACE and the PCFCD were available at each map. Participants were encouraged to ask questions of the representatives and to indicate their concerns and desires for the project by adding their comments to the comment sheets, placing labeled dots on the maps, and recording their comments on paper. A team member from Novak Environmental, Inc. was also available at each station to facilitate the session.

A. General Public Comments

Three overlying themes stood out in the comments, Recreation, Restoration and Development.

Recreation:

- Many people indicated that they wanted to see the trail system that is found west of Campbell continued, including the trail amenities like parking lots, drinking fountains, equestrian access points, etc.
- People like that the North bank has paved trails for bikes, etc. and the South bank has unpaved trails for pedestrians. They would like to see this continue.
- Equestrian access was a major point, many people use the river bed to ride their horses and are very concerned that this be allowed to continue. Equestrian access is desired from both the north and south banks, at many locations throughout the study area. Equestrians also indicated that for safety reasons, equestrian access (ofcial and unofcial) is needed frequently so riders are able to get out of the river in the case of a flood.
- Several people indicated that they did not want to see soccer fields and other lighted sports fields developed within the study area. Many people indicated that they wanted to see the area stay as "natural' as possible.
- People requested that shaded recreation areas be provided in the design- specially trees that would shade the pathways and rest areas.
- Neighbors were concerned that access to the study area be provided from nearby neighborhoods, and that both vehicular, pedestrian, and equestrian access be addressed.

2. Habitat Restoration:

- Mesquite bosque and grassland restoration, both in the channel bed and the overbanks was considered desirable.
- Though most people gave a general acceptance of the existing bank protection; understanding the need for existing food control, but would like to see other bank options explored in future projects. Suggestions included planting banks with cottonwood, bioengineering, etc.
- People wanted to know if water would be put back in the river.

- People also asked about groundwater recharge in the river. Some expressed that they would like to see more of this. However, equestrians wanted the recharge areas to be clearly marked because the soft ground in these areas can be dangerous to horses.
- There were suggestions made that some areas be turned into wetlands, to facilitate groundwater recharge and provide wildlife habitat.
- Several people suggested that storm water in the channel needs to be slowed. The channelization of the creek has increased water velocities, preventing the water from pooling or ponding and creating the temporary wetlands/recharge areas that historically formed in the channel. (Possible detention areas or areas of open water in channel?)
- There were also concerns raised about tributary channels and the maintenance and restoration of these channels as well.
- There was a general concern that vector control be addressed in any areas of open water.

3. Existing and Future Development

- There was concern that the planned changes to River Road will impact the study area and this should be addressed and coordinated within the Feasibility Study.
- Several people indicated that they did not want to see commercial development along the river.

It was also expressed by several people that they would like to see local, Tucson consultants working on the Feasibility Study and the Design and Implementation of this project. The public is concerned that people from outside the area (California) are not familiar with the Rillito, the local ecosystems, plants, and desires of the residents of Tucson. They felt that local consultants could be more responsive and better understood the unique hydrology and ecology of the Rillito. This was also expressed in an E-mail response which can be found in Appendix B of this document.

B. Specific Workshop Comments

These comments were placed on the maps and comment boards provided.

SPECIFIC COMMENTS GENERATED FROM MAP WORKSHOPS

- Keep south bank pedestrian (unpaved)
- Keep equestrian access from both north and south banks
- Provide equestrian access from the south bank
- Indicate locations of recharge areas for equestrian users
- Do not reduce access points for equestrians – Safety during floods
- Provide shaded recreation areas—trees along pathways, etc.
- Water in the channel at specific points
- No further narrowing of bed and floodplain
- Slow water down
- Explore alternatives to soil cement banks
- Try to get back to 50 years ago
- Look at effect of powerlines and wildlife habitat
- No reclaimed water
- Detention areas to slow water / provide habitat
- Address flooding at the bend in River Road
- Maintain Equestrian access
- Vector control throughout project
- Maintain channels and tributaries
- Restore Grasslands/ riparian vegetation
- Extension of recreation facilities (trails, water fountains, rest rooms, parking lots, etc.) like west of Campbell
- No parking lots
- No soccer fields

FROM DOTS ON MAPS

- Currently significant soil and hill erosion on north side of river walkway- needs to be reversed soon, with permanent solution formal design. Growing cottonwood trees off the sidewalk would help. (At bend in Rillito west of Country Club Rd.)
- Christmas wash is being degraded because it is being used as a 'default' parking lot near the river. As a protected wash, it is important to restore this area also. (At Christmas Wash and the Rillito)
- Craycroft wash traditional trail connects to Rillito – Request it remains open – important for equestrian usage, as there is very little access remaining for horse riders elsewhere. (West of Craycroft)
- Don't let "liability issues" prevent a quality solution
- Need to study effect of any increased infiltration upstream of Columbus landfill mobilizing contaminants, i.e., creating leachate that would impact groundwater. (At Columbus Road, south of the Rillito)
- Equestrian access along entire wash (East of Swan, West of Alvernon, East of Christmas Wash)
- Equestrian paths along river
- Concrete berms for water recharge – more or less? (East of Country Club where river bends to North)
- It's oddly mis-prioritized to run Colorado River water down the Rillito River
- Maintain culverts better. Swan and Craycroft and elsewhere, and enlarge if necessary (At Swan and Craycroft)
- Affect on tributary going into River such as Christmas Wash as it goes through Winterhaven (On Christmas Wash, south of study area)
- Formation of an earthen dam for recycle of natural water as it is formed by lake (Between Dodge and Country Club near TEP property)
- Equestrian Paths / Access throughout between Craycroft and Swan
- Water in River between Swan and Alvernon.
- No Soccer Fields (Undeveloped area south of the river between Swan and Alvernon)
- Restore destroyed trees and grasses (Undeveloped area south of the river between Swan and Alvernon)
- Clean up and Plant (North of the river, east of Valley View wash and south of River Road)
- Keep South bank pedestrian (throughout study area)
- Bridge crossing Rillito at Alvernon (At Alvernon)
- No bridge at Alvernon
- Equestrian access (at Alvernon – north of the river)
- Horse access (on north bank between Dodge and Country Club)
- No commercial development (north of River road at bend in road)
- No additional development (near the bend in the Rillito, between the Rillito and River Road)
- Already too much noise (On River Road between Country Club alignment and Christmas Wash alignment)
- Horse access (On north bank east of Christmas Wash alignment)
- Keep Open (Park) (Undeveloped area owned by City of Tucson, south of the Rillito, east of Christmas Wash)
- Horse properties (South of study area, east of Christmas Wash)
- Restore/Revegetate Christmas Wash (On Christmas Wash)
- U of A Extension Farm (East of Campbell, south of the Rillito)

No person or entity present at the public workshop raised any controversial aspect against a general proposal to restore native biota and habitat within the Study Area. Similarly, no person or entity has brought objectionable issues to the Corps' or County's attention since then. To the best of our knowledge, no positions opposed to restoration of ecosystem features on the Rillito River have been expressed.

A public meeting was conducted January 28, 2004, to gather comments and responses on the Draft EIS. The comments and responses, as well as the meeting transcript, are included in Attachment C. For more information on the community involvement effort conducted as part of the Feasibility Study, please refer to Appendix J of the main report.

Chapter 3.0
Alternatives

3.1 Background and Introduction

The El Rio Antiguo Feasibility Study is an ecosystem restoration study being conducted by the U.S. Army Corps of Engineers, Los Angeles District (USACE) and the Pima County Flood Control District (PCFCD). Ecosystem restoration is the primary purpose of this study. The Rillito River is commonly called Rillito Creek. The study is called El Rio Antiguo to distinguish it from previous studies and projects with similar names, in addition to its cultural significance. The Rillito is a significant tributary of the Santa Cruz River in Arizona. The study area consists of that portion of the Rillito River extending from Craycroft Road to Campbell Avenue in Tucson, Arizona as shown in Figure 1-1 in Chapter 1.

This chapter discusses the evolution, evaluation, and discussion of alternatives for this study. Additional details regarding alternative analysis are discussed in the El Rio Antiguo main report, and specific details about the ecosystem functional assessment can be found in the El Rio Antiguo Functional Assessment Procedure report (Appendix K to the El Rio Antiguo main report).

3.1.1 1830 to Present

The Tucson watershed and associated habitat has been significantly altered in the past one hundred years. In the early 1800s, the riparian area along the Rillito, and the Rillito River itself was profoundly different. Dense stands of cottonwood, willow, and ash lined the river while mesquite bosques spanned out over the floodplain. The Rillito actually flowed perennially. Historical accounts describe the Rillito as a tree-lined, narrow river with dense vegetation winding throughout the riverbed and vicinity. Wildlife was abundant, and beaver dams, which facilitated backwater area, were common.

The water supply provided by the Rillito, Tanque Verde Creek, and Pantano Wash spurred early settlement of the area. Farming and ranching dominated the south side of

the Rillito. In 1873, the water supply played a role in the relocation of Fort Lowell to south of the Pantano Wash. During the early 1900s, the north side of the Rillito was home to the Mormon settlers who developed the Binghampton irrigation system, and produced a wide variety of crops. As early as the 1920s, the human effects on the Rillito and its once lush riparian oasis was evident. The riverine system showed signs of being unreliable due to the lowering of the groundwater table, which prompted the drilling of wells to supplement the surface water supply.

Due to agriculture and rural development of the region, the Rillito had become a wide channel with vertical banks by the 1900s. Things that lead to erosion and habitat destruction include removal of floodplain grasses, overgrazing of cattle, erosion along cattle trails, and summer flooding due to the loss of beaver dam storage and riparian wetlands. The river is now devoid of any substantial growth of vegetation.

Today, continued groundwater pumping, along with the ever-encroaching human development, has reduced the Rillito to a cement-lined channel, void of historic lush vegetation and abundant wildlife, with a few remaining scarce cottonwood trees. Human alteration of this riverine system, groundwater supply, and landscape has resulted in a river that flows intermittently with sparse vegetation and the near loss of ecosystem functions. Overall, it is estimated that Pima County has lost 85 to 95 percent of quality riparian areas over the past 100 years. This somewhat grim state of the Rillito River presents the ideal, and justifiable, opportunity for ecosystem restoration.

3.1.2 Pima County's Desires

Given the rapid decline and dramatic degradation of riparian areas that once flourished along the Rillito, Pima County has demonstrated a strong interest in wanting to restore this degraded, but valuable ecosystem. Pima County (Department of Transportation and Flood Control District) has been identified as the local sponsor of this ecosystem restoration study. The opportunity exists to use knowledge gained from existing ecosystem restoration projects and use other water sources to expand and sustain riparian and cienega habitats along the Rillito.

Many ecosystem restoration opportunities exist in this part of the Rillito including the chance to increase the amount and quality of mature, native vegetation in and along the riverbed, and to improve degraded ecosystem functions including important hydrologic connections. Pima County would like to restore critical riparian and cienega habitats that have been lost in the region due to water resource changes in the area.

3.1.3 Public's Desires

Throughout this study planning process, public input has been solicited through a variety of avenues including newspaper articles, public information mailings, coordination with special-interest groups, public workshops, and public scoping meetings. As a result, a citizen's committee was formed. Local citizens use the study area as a river park for recreation, including equestrian and dog outings. They value the Rillito as a wildlife habitat corridor and a corridor for equestrians, pedestrians, bicyclists and others seeking recreation opportunities. Local residents develop their knowledge season by season, through experience, and collective memories. This local knowledge is valued as a resource because it provides information about the area, plants, wildlife, history, constraints, and possibilities for the area.

Primary concerns identified by the citizen's work group include access to the Rillito and existing trails; use of native vegetation for restoration; wise use of water; providing wildlife habitat; visual impact of the project; using interpretive signage; and working with neighbors. The citizen's group developed suggestions for improvements to the area that included ecosystem restoration measures as well as other measures to improve the area. Ecosystem restoration suggestions include using reclaimed water for irrigation of vegetation, improvement of birding area, water harvesting, particularly in the Finger Rock Wash bend area, creation and restoration of cienegas, preservation of an existing mesquite bosque on the north bank between Swan and Craycroft, and using vegetation screens to block the view of the electric transmission station. Other suggestions for area include addition of a pedestrian bridge, addition of an equestrian access ramp, and trail linkage.

3.1.4 General Nature of Preliminary Alternatives

During the course of this study, many measures were considered, and alternatives formulated to meet the restoration goals. This alternative formulation process involved successive iterations, and intense scrutiny and subsequent elimination or refinement. Alternatives and measures were evaluated on the basis of environmental, technical, economic, and public feasibility. An early depiction of a possible configuration of a restored ecosystem landscape is depicted in Figure 3-1. This image was a result of a brainstorming session focusing on restoration possibilities. Eventually, three preliminary alternatives emerged. Each of the preliminary alternatives focus on a particular defining measure, yet still retains many similar measures. The first preliminary alternative focuses on basins, particularly the implementation of basins in the bend area that would harvest water and contain restored cottonwood willow and mesquite communities. The second preliminary alternative focuses on terraces in the bend area. The terraces would have three levels, each containing a mesquite, cottonwood willow, or scrub/shrub community. The terraces would involve removing soils cement in order to widen the floodplain to

El Rio Antiguo Project

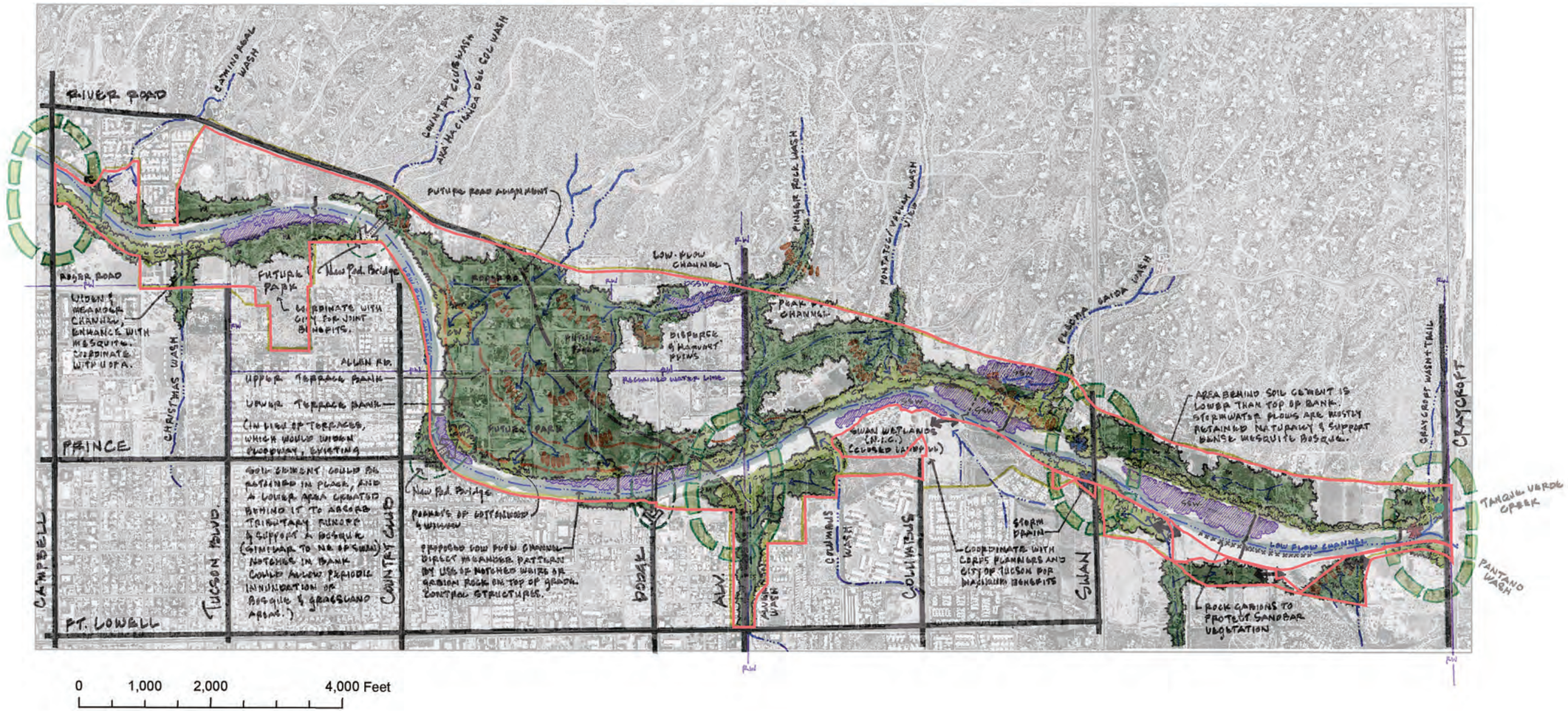

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FIGURE 3-1

El Rio Antiguo Potential Restoration Configuration

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mimic historic condition, and restore the hydrologic connection between the river and the vegetation communities on the terraces. The third preliminary alternative focuses on channel restoration using inflatable barriers and gabions that would direct water flow to protect vegetation communities (mostly scrub/shrub and some cottonwood willow), along with creating important backwater areas to promote the establishment and growth of vegetation in these areas. Measures common to these original three preliminary alternatives include small basins in the upstream area of the Rillito to harvest water, high and low flow channels in the bend area for Finger Rock Wash to divert and harvest water, and, similar to the channel restoration alternative, the basins alternative also includes gabions for channel restoration.

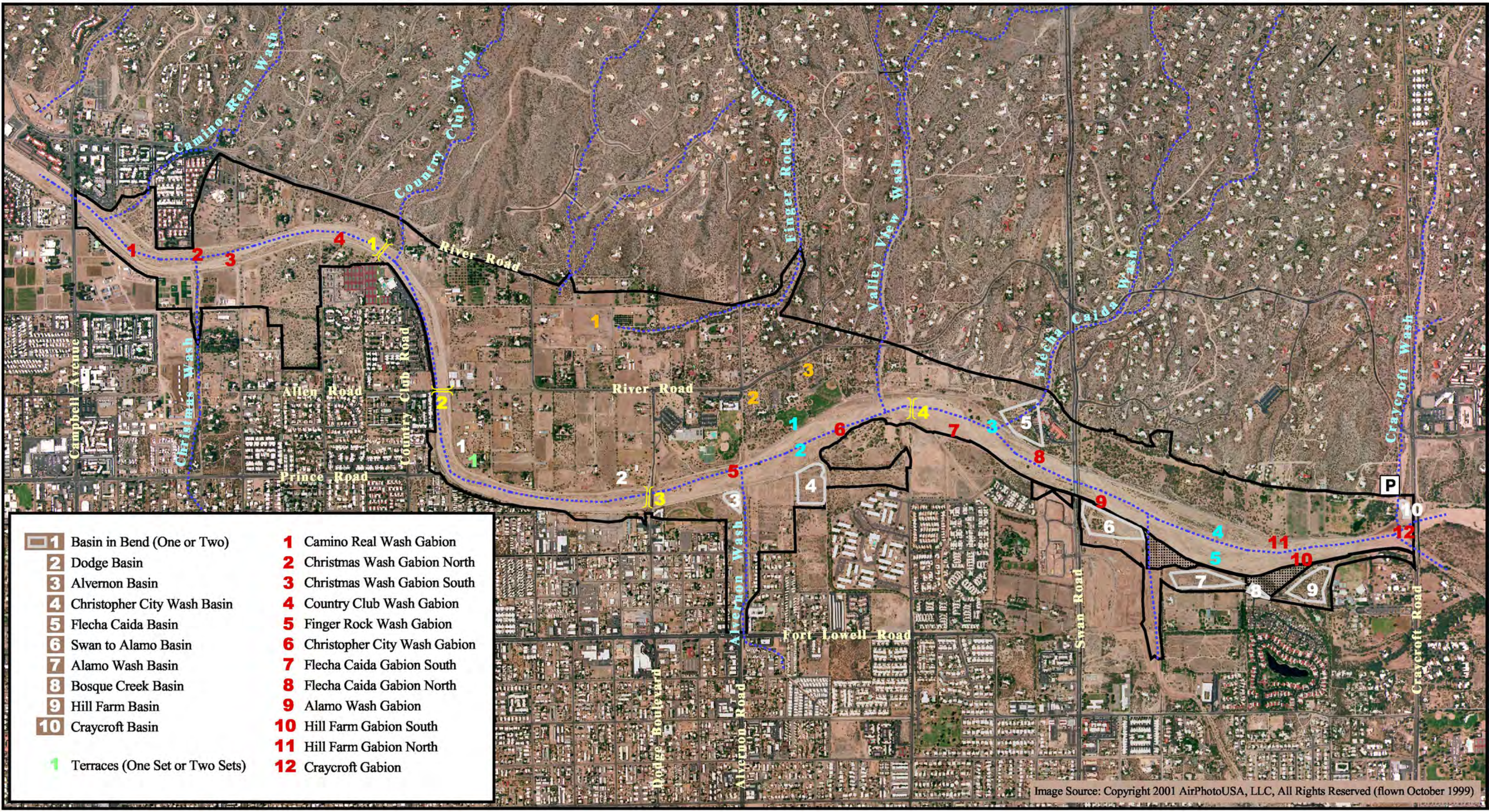
3.1.5 Goals of Study

Ecosystem restoration is the primary purpose of this study and it involves the improvement and restoration of the natural ecological characteristics and functions of a portion of the Rillito River. This Feasibility Study explores ways, goals, and effects of opportunities to restore critical riparian habitats that have been lost or degraded due to water resource changes in Pima County. Objectives of this ecosystem restoration study include the improvement, restoration, and expansion of sustainable riparian and cienega habitats along the Rillito. Other objectives seek to increase and improve wildlife habitat value and diversity for threatened, endangered, and sensitive species, as well as critical ecosystem processes and functions. Hydraulic objectives focus on maximizing opportunities for water harvesting, and restoring important hydraulic connections.

The general approach to accomplish these goals is to first restore hydraulic connections between the river and washes, channels, basins, and adjacent vegetation communities. Restoration efforts would mimic historic, natural conditions harvesting water, trapping sediments, facilitating water absorption, and providing water to vegetation. Next, vegetation communities, both in and adjacent to the river channel, would be improved with supplemental plantings and irrigation. With the restoration of the vegetation communities, habitat structure should improve and there should be an increase in the wildlife species, as well as diversity, in the area. This approach to restoration, focusing on the wetland functions as well as the habitat and vegetation structure, will eventually lead to a more natural ecosystem with wetland functions, habitat structure, and dynamic processes that are signs of a healthy ecosystem and a successful ecosystem restoration.

3.2 Alternatives

For the El Rio Antiguo study, various restoration measures, such as basins, terraces, and gabions, were considered. Figure 3-2 shows the approximate location of the potential measures that were combined in various ways to form the original three alternatives. Following the measures discussion, the preliminary three alternatives are described, and



El Rio Antiguo study area

Not included in El Rio Antiguo study area

N 0 Feet 1500

1 Pedestrian Bridge near Country Club Wash
2 New Pedestrian Bridge near Bend Area
3 Converted Pedestrian Bridge at Dodge
4 New Pedestrian Bridge at Columbus

1 Low Flow Channel
2 High Flow Channel
3 Remnant Irrigation Channel

1 Christopher City Wash Inflatable Barrier North
2 Christopher City Wash Inflatable Barrier South
3 Flecha Caida Inflatable Barrier
4 Alamo Wash Inflatable Barrier North
5 Alamo Wash Inflatable Barrier South

P Additional Parking near Craycroft

Rivers/Washes

FIGURE 3-2

Measures Considered in the Alternatives

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a brief description of the variation and expansion of the preliminary three alternatives into 44 alternatives. Next, the 44 alternatives were winnowed to the 20 alternatives that were analyzed in the ecosystem functional assessment. The ecosystem functional assessment is briefly discussed in the Section 4.3, Biology, and details can be found in the El Rio Antiguo Functional Assessment Procedure report (Appendix K to the El Rio Antiguo main report). The next discussion details the elimination of alternatives from further consideration, and the top three alternatives that emerged in the analysis procedure are discussed. This chapter concludes with the discussion of the no action alternative and the array of final alternatives.

3.2.1 Measures Considered But Eliminated

For the El Rio Antiguo study, several restoration measures were considered for alternatives. Some, such as basins, terraces, gabions, inflatable barriers, and high and low flow channels, were selected for inclusion in the alternatives. Other measures, such as a sedimentation basin in Finger Rock Wash, wood or brush gabions, and a single low flow channel in the bend area, were considered, but eventually eliminated due to design reasons and other limitations. Individual measures considered but eliminated are discussed below.

3.2.1.1 CAP Water

Central Arizona Project (CAP) water was considered as an ancillary water source for this study. The CAP delivers Colorado River water from Arizona's allocation to various locations in the state, including Tucson. This measure was eliminated from further consideration due to technical and economic feasibility issues.

3.2.1.2 Grade Control Structure Modification

In order to promote a meandering low flow channel, the possibility of cutting a shallow notch in the grade control stabilizers was evaluated. The notch may not be effective in directing the water to follow a low flow channel. The presence of a notch may not be sufficient to overcome the natural tendency of a low flow channel to either meander or braid itself laterally across the channel bottom. Past experiences have shown that the channel will cut its own low flow channel upstream and typically flow over the grade stabilizer at some location other than at the notch. For these reasons, modifying the grade control structures with a notch to direct low flow was not selected as a viable measure to implement in the alternatives.

a. Soil Cement Removal or Modification

The possibility of removing or modifying the soil cement to allow restoration of river banks to a more natural state was excluded from most of the study area because it was

considered to have the potential of becoming economic infeasible, as well as the potential for flood control issues and safety concerns. Eventually, the possibility of removing a small section of soil cement in the bend area to construct terraces was selected, since the terraces would widen the river channel and still contain flows, particularly because the highest terrace would be at the level of the soil cement.

b. Land Acquisition

The possibility of acquiring land in the study area to restore communities and promote a buffer to minimize human disturbance was considered. However, in the end, the study area is in a residential area, there is not a whole lot of undeveloped areas remaining, and real estate costs would quickly become economically infeasible.

c. Open Water

The possibility of creating year-round or seasonal pools or channel reaches with flowing water was considered to support restoration of aquatic habitat and benefit migratory waterfowl as well as other wildlife species. This measure was eliminated from further review because of the potential for vector problems associated with standing water.

d. Finger Rock Wash Sedimentation Basin

A sedimentation basin in Finger Rock Wash was excluded because of several factors. First, it would be very costly and not very economically feasible. In addition, it is not clear that a sedimentation basin is necessary for the functioning of the low and high flow channels in the bend area. Also, relatively clear water (mostly sediment-free or at least of significantly reduced sediment load) from the sedimentation basin would cause potential scour in the downstream channels and therefore would require extensive bend and bank stabilization. The sedimentation basin would entail high maintenance costs for regular removal of deposited sediments. Finally, the sedimentation basin would involve construction of a dam across the channel and some overbank areas for temporary storage of water and sediments, which would disturb natural flow regime in downstream channels. For these reasons, the sedimentation basin in the bend area was not considered to be a viable option in any of the alternatives.

e. Gabions Filled with Wood or Brush

Using vegetative gabions filled with wood or brush material was considered, especially since the gradual decay would contribute to the coarse and fine woody debris in the study area, which is desirable, but ultimately not selected. Because the gabions are expected to wash out during periods of high flow, there would be an associated economic cost for higher maintenance, since the vegetative gabions would likely wash away more frequently than gabions filled with rocks. Gabions filled with wood or brush material would not be as free standing as gabions filled with rocks. So the possibility of using gabions filled with wood or brush material was not selected.

f. Gabions Anchored to Soil Cement

The possibility of anchoring the gabions to the soil cement was not selected because when the gabions would wash away during high flood events, the soil cement could be damaged.

g. Meandering Berms in the Bend Area

In the bend area, the possibility of creating meandering berms to direct and distribute water flow across this area to the terraces or basins along the Rillito was discussed; however, this measure was not selected. Because of the historical Binghampton site, and the significance of this historic farming landscape in the bend area, it may have been difficult to implement a meander for water flow following a natural course and completely avoid cultural resources, so this measure was not selected. As an alternative, high and low flow channels would be constructed in the bend area to direct the water from Finger Rock Wash to the Rillito, and the basins or terraces along the river.

h. Finger Rock Wash High and Low Flow Channels

As an alternative to the meandering berms, the construction of high and low flow channels in the bend area was considered to direct the water from Finger Rock Wash to the Rillito, and the basins or terraces along the river. When considering the implementation of a low or high flow channel in the bend area, consideration of a Detailed Project Report, *Lower Finger Rock Wash, Tucson, Pima County, Arizona*, prepared by the USACE in 1996, by Study Team engineer and hydrologists, indicates that both the low and high flow channels are necessary. The construction of only one channel for Finger Rock Wash would be ineffective. The slope of the channel would not be enough to transport sediment, which would create a maintenance problem. Therefore, any alternative that includes the low flow channel in the bend area as a measure, must also include the implementation of the high flow channel, and vice versa. So, the construction of only the low flow channel in the bend area was not considered.

i. Mesquite Bosque in the Bend Area

Restoring the bend area with mesquite bosque community was considered, particularly the expansion of a mesquite community that would cover the entire bend area. Implementation of this measure may have potentially displaced residents, as well as cultural resources. Due to potential economic feasibility, as well as cultural resource concerns, this measure was scaled back to a more feasible measure that includes restoration of mesquite, as well as cottonwood willow and scrub/shrub communities in the bend area.

j. Buffer Areas Surrounding Study Site

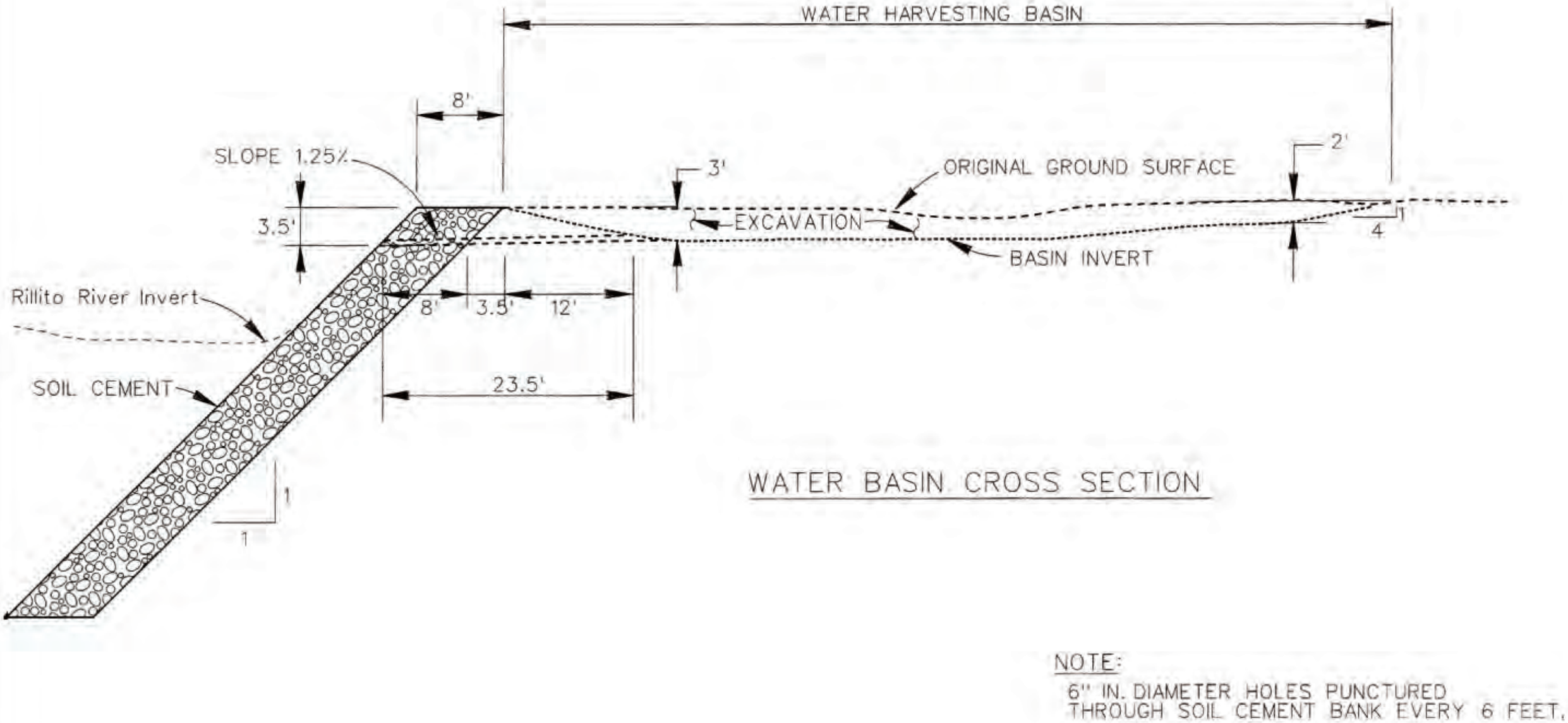
Ideally, restoration of this ecosystem for wildlife purposed would include a buffer area that would minimize human disturbance to habitats and wildlife. Existing parks in the study area are suitable for buffer areas. Because of the residential nature of the study area, most surrounding areas, other than the parks, are already or will be developed. The possibility of implementing a buffer around the entire study site is not feasible due to economics and potential displacement of residents. This should not imply that these potential human influences diminish the value of this restoration study, rather, this restoration study provides the opportunity to restore an ecosystem that has persisted under human influence and alternative, and provides an ideal opportunity for ecosystem restoration and the ability to provide an important corridor link for wildlife as well as ecosystem processes and functions. The value of this potential ecosystem restoration study should not be overlooked, diminished, or compromised because of the surrounding human landscape and lack of available buffer.

3.2.2 Measures Selected to Be in Alternatives

The main hurdle to overcome in this ecosystem restoration study is the limited amount of water. Therefore, measures that make the most of natural water sources were the focus of alternative formulation. Passive capture of water using grading and contouring of basins and flow channels promotes the water harvesting of local runoff. Excavation of basins and reconfiguration of channels aimed to capture water with the least amount of maintenance as possible. The terrace measure focused on restoring the hydraulic connection between the river and floodplain, as well as maximizing the harvesting of water. The next several sections present the main measures selected to be in the alternatives, as well as the specific placement of the measure, and the associated vegetation communities that would be restored. A cumulative figure of measures considered in the alternatives is depicted in Figure 3-2.

3.2.3 Basins

Basins would be designed to harvest water to control stormwater runoff, increase soil moisture, and to maintain and restore vegetation. Figure 3-3 shows a diagram of a water harvesting basin. The basins would retain water, which would improve absorption of water into the soil and provide water for vegetation in the basin. The basins would have subsurface drainpipes connecting to weep holes through existing soil cement banks. In some cases, particularly where weep holes are likely to be clogged by debris and have high maintenance costs, this obstacle may be solved by using a modified weir that would



Source: USACE, 2002

FIGURE 3-3
Water Harvesting Basin

retain water in the basin, yet it would be configured with a notch, or some other modification, that would allow the water to drain from the basin. In general, the upstream basins would have a modified weir structure to allow for drainage, and the bend area and downstream basins would have weep holes to allow for drainage. Drainage of the basins is important because this gradual drainage would minimize opportunities for mosquito populations while providing critical hydraulic connection to the river.

3.2.3.1 Downstream Basins

The Downstream Basins would be located along the north bank of the riverbend area, extending west from the vicinity of Dodge Boulevard. The basin in the bend area measure was varied to consider having one or two basins in the bend area. The reason for considering one or two basins is to allow flexibility to locate the measures to avoid any potential cultural resource impacts, consider real estate costs, reduce potential impact to local neighbors, and reduce the hydraulic impacts such as induced flood or scour, as well as biological reasons.

a. One Basin in Bend Area

One basin would extend along the bend area, tapering and mimicking the former scour width at the riverbend in the 1940s. The basin would be approximately 4,300 feet in length along the river's edge, and it would encompass approximately 33 acres, tapering to mimick the former scour width of the Rillito in the 1940s. Historic aerial photographs would be analyzed and used to determine the final delineation. Figure 3-3 shows a 1941 aerial photo of the Rillito River. The basin would be excavated behind the existing soil cement to capture and contain stormwater flows, improve soil absorption, and allow sediments to settle. The soil cement in this area would be punctured with weep holes (at approximately six feet on center, or as site-specific conditions require) in order for water to drain within approximately 24 hours. This drainage is for public health purposes, to avoid standing and stagnant water and associated mosquito and other vector problems. The weep holes would be located at the bottom of the basin and drain at a slight angle into the Rillito approximately three and a half feet below the top of the soil cement on the river side. Wide mesh screens would be placed over the openings to prevent feral animals from using them for dens during dry periods while still allowing smaller sediment to flow through. These weep holes would require periodic maintenance to remove debris that may impede the drainage of water. The depth of the basin would be approximately two feet deep on the Finger Rock Wash side, graded at a 4:1 gentle slope to a depth of three feet at the soil cement side.

The basin would be planted with Mesquite bosque vegetation, transitioning to a band of cottonwood willow forest with hackberry along the edge of the river behind the soil cement. This single basin would be approximately 4,300 feet in length. Distance between plants and plant communities will follow guidelines provided by ERB for this.

Additional details pertaining to the restoration measures for plant communities are discussed in the Plant Communities section.

b. Two Basins in Bend Area

Two basins, the Bend Area Basin and the Dodge Basin, would be created to provide mesquite and cottonwood willow vegetation. The two basins together would total approximately 6,400 feet in length and would include the majority of the Bend Area basin discussed above. The two basin alternatives would avoid impacts to cultural resources in the bend area by splitting the one larger basin into two smaller basins and shifting their locations slightly.

The Dodge Basin would extend from Country Club past Dodge, approximately 2,300 feet in length at the river's edge, to mimic the width and extent of former scouring patterns of the Rillito River in the 1940s. The basin would be approximately 15 acres in size, and would taper across the bend area mimicking the former width of the Rillito in the 1930s and 1940s. The basin would be excavated behind the existing soil cement to capture and contain stormwater flows, improve soil absorption, and allow sediments to settle. The soil cement in this area would be punctured with weep holes (at approximately six feet on center, or as site-specific conditions require) in order for water to drain within approximately 24 hours. This drainage would allow the slow drainage of Finger Rock Wash flows and seepage from high Rillito flows, while addressing public health concerns to avoid standing and stagnant water and mosquito and other vector problems. The weep holes would be located at the bottom of the basin and drain at a slight angle into the Rillito three and a half feet below the top of the soil cement on the river side. Wide mesh screens would be placed over the openings to prevent feral animals from using them for dens during dry periods while allowing smaller sediment to flow through. These weep holes would require periodic maintenance to remove debris that may impede the drainage of water. The depth of the basin would be approximately two feet deep on the Finger Rock Wash side, graded at a 4:1 gentle slope to a depth of three feet at the soil cement side.

The basin would be planted with mesquite bosque vegetation, grading to a cottonwood willow forest along the edge of the river behind the soil cement. The total length of the two basins would be approximately 6,400 feet in length. Distance between plants and community members will follow guidelines provided by ERB for this. Additional details pertaining to the restoration measures for plant communities are discussed in the Plant Communities section.

3.2.3.2 Upstream Basins

The upstream basins would be located along both banks of the river, extending east from the vicinity of Dodge Boulevard to Craycroft. The basins would be located near washes

to maximize water harvesting efforts. Overall, the individual sizes of the eight upstream basins would be smaller than the downstream basins in the bend area. A few areas where the upstream basins would be located, in particular by Flecha Caida Wash and Hill Farm Basin, already have an existing depression in the ground where the basin would be located.

Basins would be designed to harvest water to control stormwater runoff, increase soil moisture, and to maintain and restore vegetation. Figure 3-4 shows a diagram of a water harvesting basin. The basins would slow water flows, which would improve absorption of water into the soil and provide water for vegetation in the basin. The basins would have a modified weir structure that slows water flow, but would not require dredging operation and maintenance costs. Weep holes, or subsurface drainpipes connecting to weep holes through existing soil cement banks, may have the tendency to clog with debris and may require frequent operation and maintenance costs. Therefore, a modified weir structure would typically be used in these basins for drainage, and also to keep maintenance costs down. The modified weir structure would allow for the gradual drainage of basins, minimizing opportunities for mosquito populations, and providing critical hydraulic connectivity to the river.

a. Alvernon Basin

The Alvernon Basin is approximately one acre in size and is located along the south bank at the north end of Alvernon Wash. This basin is tapered from the entry at Alvernon and Columbus washes to a depth of 3 feet on the Rillito River side. The edge of the basin would have a 4:1 gentle slope. A mesquite bosque would be planted in the majority of the basin, with a band of cottonwood willow forest placed at the fringe of the basin. The location of the cottonwood willow and mesquite bosque communities was determined by the biological, topographical and water requirements of these communities. The cottonwood willow forest at the fringe of the basin would, overall, receive more water, whereas the mesquite area in the basin would receive enough periodic inundation, yet less than that of the cottonwood willow fringe. This basin would have a modified weir that would drain any standing water within 24 hours.

b. Christopher City Wash Basin

This basin, which is approximately six acres, is located along the south bank at the east end of the Swan Wetlands 1135 project. The basin would taper from the entry of Christopher City Wash toward the Rillito River to a maximum depth of three feet. The slopes at the river would be 4:1. This basin would be similar in design to the Hill Farm Basin. This basin would be planted with vegetation similar to a cottonwood willow forest community. Cottonwood willow vegetation is suited for this location due to the expected inundation frequency of the basin from runoff, and other biological requirements. The basin would have a modified weir structure to ensure that any standing water from runoff drains in approximately 24 hours.

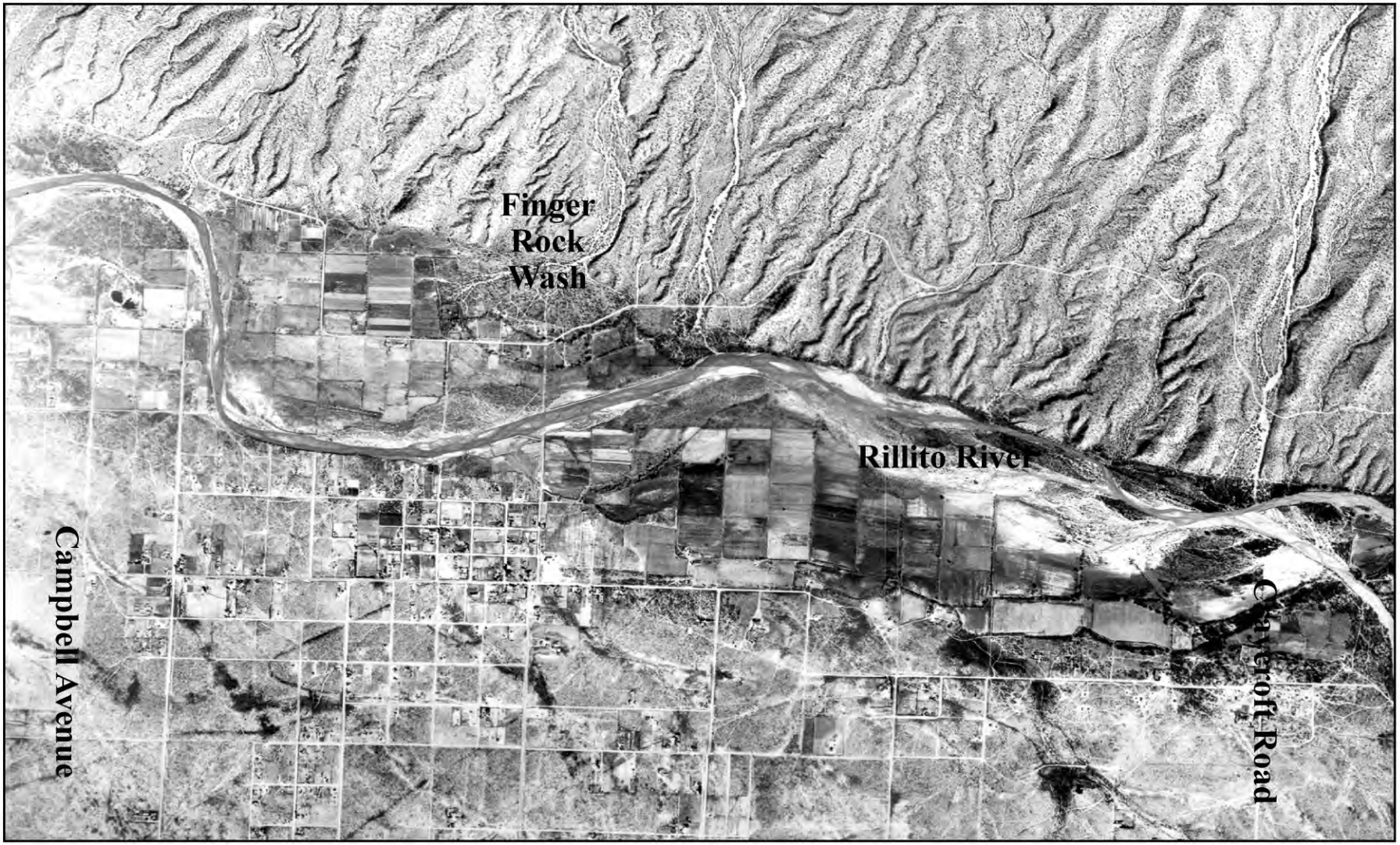


FIGURE 3-4

Historic Aerial Photo of the Rillito River

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c. Flecha Caida Basin

The Flecha Caida Basin is triangular shaped and extends south from River Road to the Rillito River along the north bank. It is approximately six acres in size. A basin currently exists in this area, but is in need of cleanup and some excavation. The basin would be tapered from the entry of Flecha Caida Wash to a depth of three feet behind the soil cement and sandbar. This design is similar to the Hill Farm Basin design. The three-foot edge of the basin would have a 2:1 protected slope. The existing cottonwood willow forest would be restored and expanded at this location, as well as restored with additional plants. A mesquite bosque would be established around the cottonwood willow community. Vegetation would be planted to improve the existing cottonwood willow vegetation, as well as the areas surrounding it. Water flowing down from Flecha Caida Wash would be captured by this basin, which would be used by the cottonwood willow community. Water draining from the modified weir structure of this basin would feed the scrub/shrub community located in the river channel adjacent to this basin. In addition, water flowing from Flecha Caida Wash that is not captured in the basin would flow downstream to the west, which would be used by the expanded cottonwood willow community, and newly planted mesquite bosque community slightly further downstream.

d. Swan to Alamo Wash Basin

This basin is approximately seven acres and would extend along the south bank of the Rillito between Swan Road and Alamo Wash. A basin currently exists in this area in a partially excavated state, but is in need of clean-up, removal of invasive plant species and some reconfiguration. The basin would be tapered from the entry of tributaries to a depth of three feet on the Rillito River side, with a 4:1 gentle slope at the edge of the river. This basin would drain any standing water with modified weir structure. A cottonwood willow forest would be planted in this basin. A cottonwood willow community is suited for this location due to the availability of the topography to catch and harvest water for the vegetation. This location also meets other biological requirements. This basin would serve to harvest the water flowing from Alamo Wash on the south side of the Rillito. Water would flow in on the east end of the basin, and continue west, flowing downstream. The modified weir in this basin would contribute water to a cottonwood willow community in the river channel, which would be protected by a gabion.

e. Alamo Wash Basin

The Alamo Wash Basin extends from Alamo Wash east towards the Bosque Creek Basin. It is approximately five acres and would be planted with mesquite bosque community vegetation. The basin is tapered from the entry of Alamo Wash to a depth of three feet on the Rillito River side, with a basin slope of 4:1. Weep holes from this basin would contribute water to a scrub/shrub vegetation community in the river channel, which would be protected by a gabion. Water flowing from Alamo Wash, a cemented wash on the south of the Rillito, would flow into the western edge of this basin, flowing northeast

toward the weep holes or modified weirs, both of which would allow the water to drain. Due to the topography, and other hydraulic and biological constraints, a mesquite bosque is ideal for this location. The mesquite community requires less water than cottonwood willow, and the modified weir would allow the water to drain into the Rillito, providing water for a restored scrub/shrub community.

f. Bosque Creek Basin

This is an existing basin along the south bank of the Rillito, at the north end of Bosque Creek. It would be enlarged to approximately 1 acre, in a tear-drop shape. This basin would extend to cover the area between Alamo Wash Basin and Hill Farm Basin, and would encompass the area between the existing dirt road and the existing basin at Hill Farm. The basin would be tapered from the entry of Bosque Creek to a depth of three feet on the Rillito River side, with a gentle basin slope of 4:1. This basin would be approximately one acre in size and would be planted with mesquite bosque vegetation. This basin would have a modified weir structure that would enable standing water to drain within 24 hours. This basin may not harvest as much water as other basins, due to the smaller size of the wash, so a restored mesquite community is ideal for this location.

g. Hill Farm Basin

This is an existing basin along the south bank of the Rillito, next to the Bosque Creek Basin at the north end of the Hill Farm subdivision. This existing basin is in need of cleaning out, invasive removal, and additional excavation. The Hill Farm Basin would be approximately five acres in size and planted with mesquite bosque vegetation. The design would be similar to the Bosque Creek basin. Similar to the Bosque Creek Basin, a restored mesquite community is best suited for this basin, and it would have a similar modified weir to allow for water drainage. The basin would be tapered from the entry of the wash to a depth of three feet on the Rillito River side, with a basin slope of 4:1. Water would flow in from the Hill Farm Wash, across the basin. The drainage from the modified weir would contribute water to a scrub/shrub community in the river channel that would be protected by a gabion.

h. Craycroft Basin

This basin would be approximately one acre. In order to create the Craycroft Basin, some of the existing backfill and cement would be removed from the bottom of the Craycroft Wash channel. A barrier would be placed at the mouth of the wash, a modified weir structure, to slow water flows as well as allow drainage. Fill would be used to reduce the gradient in the basin. There would be a horse access area at the barrier to allow easy equestrian access to the Rillito riverbed. The basin would harvest water flowing from Craycroft Wash. The drainage from the modified weir in this basin would provide water to the cottonwood willow community and other vegetation in the river channel that would be protected by a gabion structure. This basin would have a modified weir to

allow for water to drain. The basin would harvest adequate water for a cottonwood willow community.

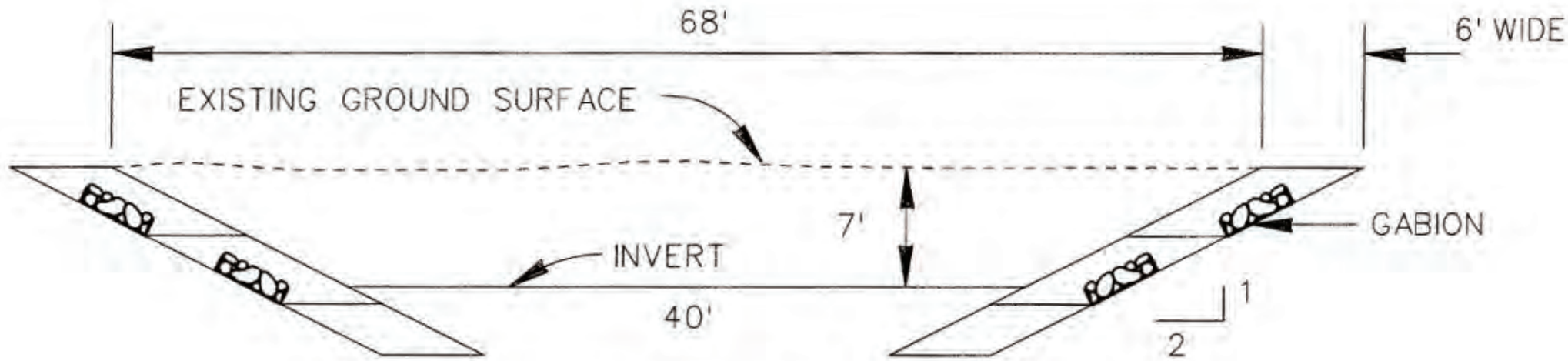
3.2.3.3 Finger Rock Wash High and Low Flow Channels

Two measures, a high flow and low flow channel in the bend area are designed to direct and distribute water flow from Finger Rock Wash through the bend area (Figure 3-5). When considering the implementation of a low or high flow channel in the bend area, consideration of a Detailed Project Report, *Lower Finger Rock Wash, Tucson, Pima County, Arizona*, prepared by the USACE in 1996, by Study Team engineer and hydrologists, indicate that both channels would need to be implemented together. One channel would not function efficiently without the other. Therefore, any alternative that includes the low flow channel in the bend area as a measure, would also include the implementation of the high flow channel, and vice versa.

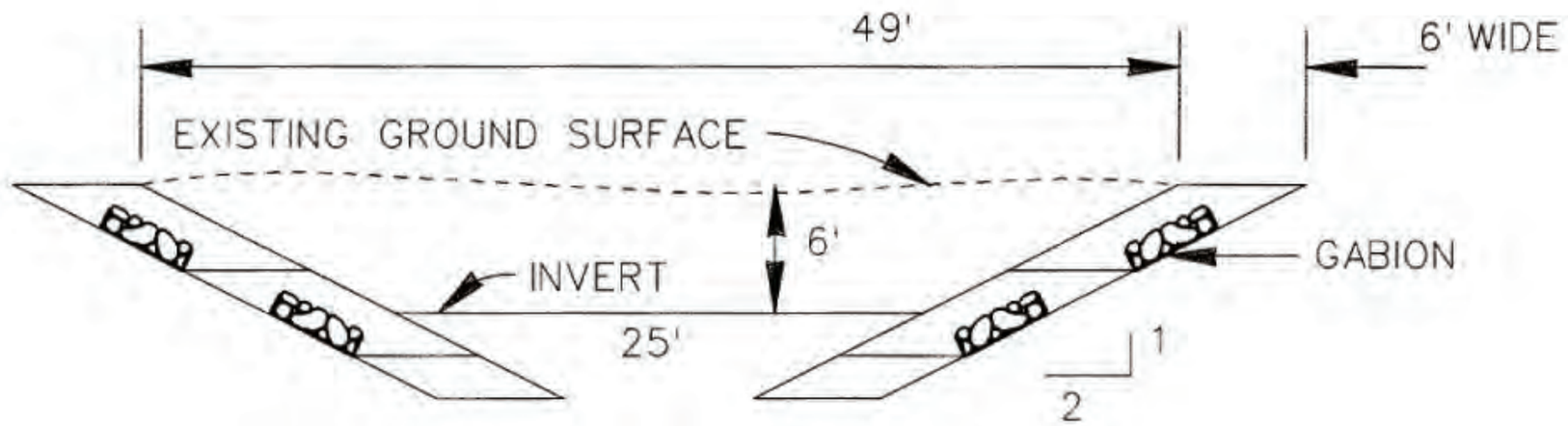
Along with improving the hydraulic and biological resources in the bend area, the high and low flow channels would emphasize the historic importance of irrigation in this area. The bend area is rich in cultural resources relating to the Binghamptom settlement, and their use of irrigation canals for farming. Using channels in the bend area for hydraulic, biologic, and historic reasons would emphasize the importance of the cultural resources in this area and would contribute to the park. The channels would be formed around historic ditches, with some reconfiguration involving light grading and excavation to create natural-looking swales. This style and conveyance system mimics the historic Binghampton method of flood control and irrigation, as well as capitalizing on a natural-looking system for flood control and irrigation.

a. Low Flow Channel

A low flow channel stabilized with gabions and vegetation would be created in the bend area from the base of Finger Rock Wash. The low flow channel would extend west from the base of Finger Rock Wash through the bend area to the Rillito River, following the general alignment of Roger Road. The channel would widen at the mouth near the Rillito to flow flows, capture water, and mimic natural channels. The channel would be graded from the base of Finger Rock Wash to three feet above the bed of the Rillito at the mouth entering the river in order to capture low flow events. The channel alignment would generally follow Roger Road, which would enable the channel to capture flows from channels that are cut off when entering at Palo Verde Road. During periods of higher flow, water would be diverted across and through the bend area, where the future County Park would be, via a series of swales and channels, mimicking natural conditions, eventually ending in the bend area basins. The “captured” water flow would ultimately be directed to inundate mesquite and cottonwood willow communities in a basin, or on terraces, which would also include a scrub/shrub community.



TYPICAL HIGH FLOW CHANNEL
CROSS SECTION (FLOWING SOUTH)
FINGER ROCK WASH



TYPICAL LOW FLOW CHANNEL
CROSS SECTION (FLOWING WEST)
FINGER ROCK WASH

Source: USACE, 2002

FIGURE 3-5

Typical High and Low Flow Channels

The intent of the low flow channel is to capture low flow events. During periods of low flow, the channel would accommodate approximately 60 percent of flow, with 40 percent diverting to the high flow channel. The channel would be designed and configured to carry approximately 2,000 cubic feet per second (cfs) (1,980 cfs is the estimated volume of the 10-year flood event). Approximately 500 cfs would be diverted from the low flow channel and distributed across the future County Park lands in a series of interconnected water harvesting basins. This additional stormwater runoff would augment the irrigation of the Park's vegetation. In the channel, mesquite vegetation would be planted with interior cottonwood willow, hackberry, and other cienega marsh vegetation, possibly even some scrub/shrub vegetation would be included. Where the low flow channel empties into the Rillito, emergent vegetation would be planted in the channel adjacent to the river channel. The low flow channel would be implemented in conjunction with the high flow channel, for maximum efficiency.

b. High Flow Channel

A high flow channel in the Finger Rock Wash would capture stormwater flows greater than the 10-year flood event and direct them south generally along the alignment of Alvernon Way. During low flow events, the low flow channel would capture and divert approximately 60 percent of the water, leaving only 30 to 40 percent of the water to the high flow channel. During periods of high flow events (greater than the 10-year event) the high flow channel would accommodate up to 60 percent of the water flowing from Finger Rock Wash and surrounding area, with the low flow channel carrying 30 to 40 percent of the flow. To the maximum extent possible, the stabilization of this channel would be achieved by the placement of vegetative gabions or other soft structural features. Since this channel would be receiving less water than the low flow channel, on average, mesquite vegetation would be planted which is less water dependent than other types of riparian vegetation. Where the high flow channel empties into the Rillito, emergent vegetation or cottonwood willow forest would be planted in the channel adjacent to the river channel, since this area would receive more water periodically than the rest of the high flow channel where mesquite is better suited. The high flow channel would be implemented in conjunction with the low flow channel for maximum efficiently.

c. Remnant Irrigation Channel

A remnant irrigation channel would connect the Valley View Wash and the high flow channel in the bend area, by Alvernon Wash on the north bank of the Rillito. The channel would be north of Mehl Park. It would receive water during periods of high flow. Mesquite bosque vegetation would be planted in this area. Mesquite community is best suited for this area, since this channel would only receive water during periods of high flow, which would be sufficient for a mesquite community. The use of this old irrigation channel between the bend and basins would prevent disturbance of the cultural

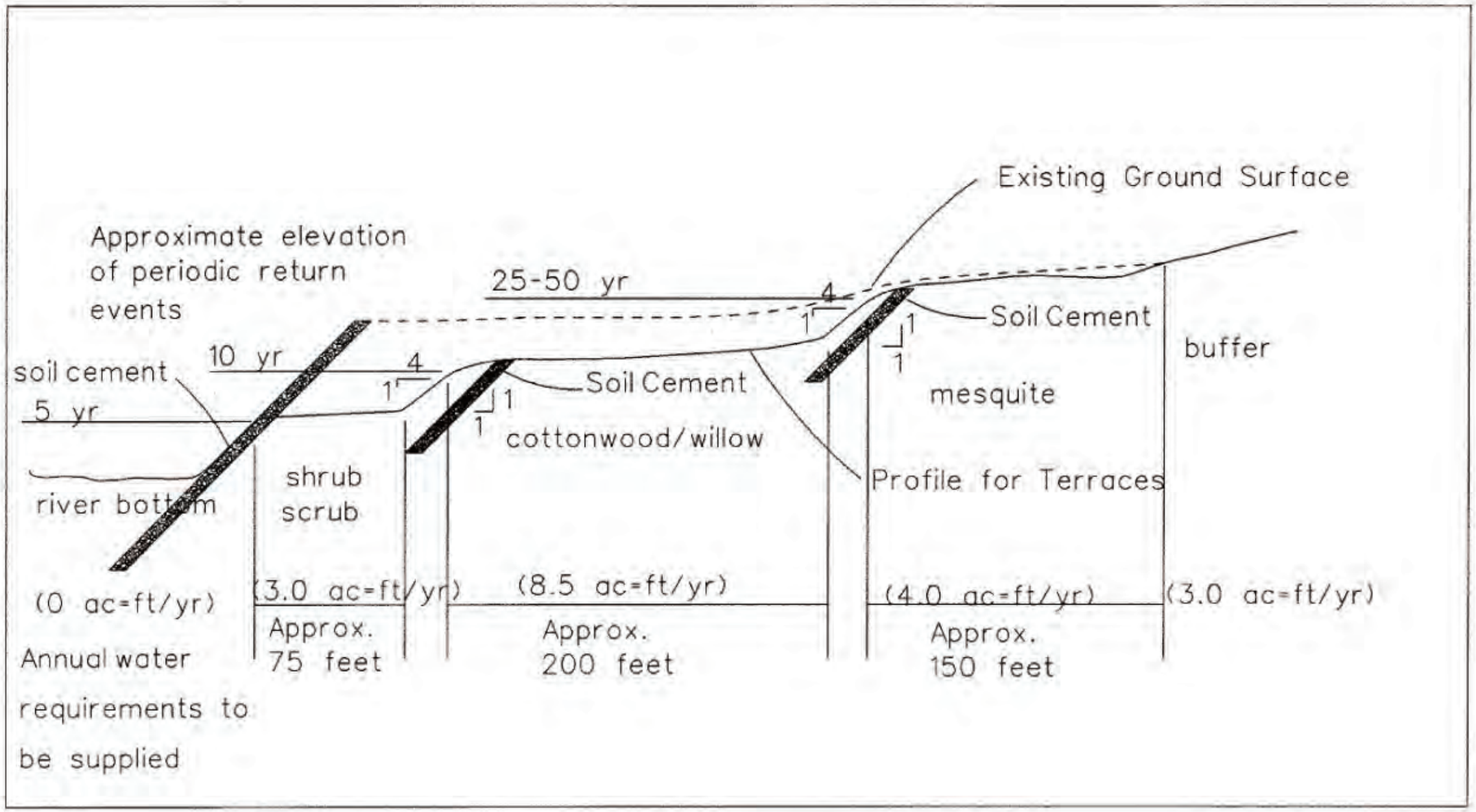
landscape. There would be a culvert between this remnant irrigation channel and the high flow channel to accommodate and direct higher water flows.

3.2.3.4 Terraces in Finger Rock Wash Bend Area

Implementation of terraces in the bend area would increase channel widths to tolerate higher flows, and add vegetation communities that mimic natural conditions. Figure 3-6 shows a diagram of terraces. Terraces would be cut in to the existing soil cement bank at the height of flow during a five-year flood event (approximately four to five feet above the river bottom). The second terrace would be constructed to accommodate flows during a ten-year event and a third terrace would accommodate flows during a twenty-year flood event. The first terrace, which would be 75 feet at the widest point, would be planted with plant species typical of scrub/shrub vegetation communities. This lowest terrace would receive the most water on average, and is best suited for a scrub/shrub community since scrub/shrub requires more water than cottonwood or mesquite. In addition, with periods of high flow, there may be some periodic scouring of this vegetation, and scrub/shrub is best suited to grow back after scour, since it is such a resilient community. The second terrace would be planted with cottonwood willow vegetation and would be approximately 200 feet at its widest point. While cottonwood requires periodic inundation, it does not require as much water as scrub/shrub, and at the higher terrace level, would still receive adequate water. Plants typical of a mesquite bosque would be planted on the upper third terrace since mesquite requires the least amount of water and is therefore best suited for the highest terrace. The third terrace would be approximately three feet higher than the second terrace and be approximately 150 feet at its widest point. A reinforced 2:1 slope would be used between the second and third terrace and the upland side of the third terrace would be contoured up to the current height of the adjacent upland area on its boundary. The terraces would be in lieu of and at the location of the previously described Dodge and Bend Area Basins. The arrangement of terraces and vegetation communities would maximize the availability of water, in addition to creating a more natural state (i.e., wider channel to accommodate higher flows) and mimicking historic conditions.

a. 1 Set or 2 Sets of Terraces

Like the basins, the terraces would consist of one set or two sets of terraces, separated to avoid impacts to cultural and historic resources. Terraces would be located and sized to avoid real estate and cultural resource issues. Having the flexibility to implement one or two sets of terraces allows room to avoid potential cultural resource impacts, and expensive real estate. One set of terraces would span approximately 4,300 feet. Under the two sets of terraces measure, one set of terraces would be approximately 4,300 feet, while the second set of terraces would be approximately 2,400 feet. So, the sets of terraces measure would span a longer distance (approximately 6,700 feet) compared to the one set of terraces measure (4,300 feet). The terraces would be spaced to increase the channel in order to accommodate higher flows, and avoid complete scouring of



Terraces design in the bend, alternative 2

Source: USACE, 2002

FIGURE 3-6

Terraces Design in the Bend

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vegetation. This arrangement of terraces on the bank would mimic historic, more natural conditions, widening the river to accommodate periods of high flow.

The arrangement of terraces would maximize the use of water during periods of flow based on water needs. The location of the vegetation communities on the terraces were determined based on biological and hydraulic requirements, and historic conditions. The three terraces, scrub/shrub on the lowest, cottonwood willow in the middle, and mesquite on the highest level, mimics what is seen in natural riparian ecosystem in the southwest. The restoration of these communities in this particular arrangement facilitates the restoration of this area to more natural, functional ecosystem.

Mesquite bosques require less water than cottonwood willow communities, so mesquite would be planted on the third, or highest terrace, receiving inundation during 25-year flows. Cottonwood willow communities would be planted on the second terrace, inundated during 10-year flows, and scrub/shrub communities would be planted on the lowest terrace, receiving water during five-year flow events. Located on the first, and lowest, terrace, the scrub/shrub communities are likely to be scoured during high flood events. However, scrub/shrub communities are quite resilient and would be more tolerant of scouring than the cottonwood willow and mesquite communities. The arrangement of vegetation communities and configuration of terraces would create a more natural functioning ecosystem that mimics historic conditions.

3.2.3.5 Craycroft Road to Swan Road Foothill Water Harvesting System

This water harvesting system would serve to irrigate the mesquite bosque area along the north bank of the Rillito, between Swan and Craycroft Roads. This water harvesting system is to intercept low stream flow with return frequency of two years and up in Rillito River at the first grade control structure downstream from Craycroft Road, divert the gravity flow through an inlet pipe to across the north bank, convey the gravity flow westward through a pipeline to a riser, and lift the pressure flow in the riser to the ground surface. The water will flow via gravity through an open channel lined with grass into an area of approximately 51 acres of mesquite bosque. The water will flow from the open channel through notches.

The system consists of an inlet pipe section, a main pipeline section, a riser, and an open channel section. The inlet pipe section has approximately 32 feet in length, 2-foot-diameter high-density polyethylene (HDPE) pipe through the north Rillito River bank with 45-degree angle. The main pipeline section has approximately 2,350 feet in length, 2-foot-diameter HDPE. Nine manholes are included to maintain the pipeline. The first manhole is located at the end of the inlet pipe and adding another manhole after each section of 250 feet pipeline. A riser located at the end of the 2,350-foot pipeline is needed to bring the pipeline flow to the ground surface. An earth open channel lined with grass

section of approximately 2,360 feet in length with trapezoidal cross section receives water from the riser and carries water westward with gravity flow to near the Swan Road. A 2-foot-wide notch opening for each 50-foot section of open channel is opened northward to provide surface runoff to irrigate the approximately 51 acres land located between the riser and Swan Road and to the north of the Rillito River.

3.2.3.6 In-Channel Vegetation

In order to allow in-channel vegetation to be planted within the Rillito River channel, gabions would be installed at various locations in the river bottom throughout the length of the study area. The gabions would somewhat direct the flow of water into a low flow channel area, while providing protection to vegetation communities. The gabions would be strategically located for direct flow into the existing low flow channel area already established in the river bottom, as well as providing protection for existing sandbars with vegetation. The gabions or other soft structural erosion control features would slow and retain water, creating backwater areas where sediment would settle out and vegetation would grow. The gabions would protect these vegetation sandbars. In general, the gabions would extend approximately 10 to 20 feet, although some may extend longer, at a 45-degree angle from the river bank. The gabions would be strategically located to protect existing and newly planted vegetation communities in the river channel. The location of the gabions and restored vegetation communities are ideally located for biological and hydraulic, as well as historic reasons. Restored vegetation communities and gabions are situated, frequently by basins and wash tributaries, to maximize the availability of water and biological resources. The periodic scouring of the restored communities in the river is ideal for scrub/shrub, since the scrub/shrub community is known for its resilience and ability to regenerate after periods of high flow. In some locations in the channel cottonwood willow communities would be restored. These locations are more suited for cottonwood since they are typically on sandbars that are slightly higher than the other areas in the river channel. While these areas would not typically receive as much water as the scrub/shrub communities, this would be all right since the cottonwood willow community does not require as much water as the scrub/shrub communities. In addition, the gabions would be appropriately located to protect the areas of cottonwood willow, as well as scrub/shrub. The in-channel restored vegetation communities would also be situated in locations that maximize the availability of the water from the tributary washes. The following gabions are named for reference purposes, and are shown in Figure 3-2.

1. Camino Real Wash Gabion: This gabion would be located along the south bank of the Rillito, across from Camino Real Wash, which empties into the Rillito on the north bank. This gabion would protect a cottonwood willow community.

2. Christmas Wash Gabion North: This gabion would be located along the north bank of the Rillito, across from Christmas Wash. It would protect a scrub/shrub vegetation community.

3. Christmas Wash Gabion South: Located on the south bank of the Rillito, this gabion would be upstream from Christmas Wash, and it would protect a cottonwood willow community.

4. Country Club Wash Gabion: This gabion would be located along the south bank of the Rillito, by the end of Country Club Road. It would protect an area of scrub/shrub vegetation. The first four gabions would be located at the western end of the study area, in relatively close proximity to each other.

5. Finger Rock Wash Gabion: This gabion would be located along the north bank of the Rillito, where the high flow channel connects with the river channel. It would protect a scrub/shrub vegetation community.

6. Christopher City Wash Gabion: This gabion would be located along the south bank of the Rillito, slightly upstream of Christopher City Wash. It would be located in an area of scrub/shrub and cottonwood willow vegetation, and it would protect an area of cottonwood willow vegetation slightly downstream. The cottonwood willow community would benefit from the water harvesting and weep holes in the Christopher City Wash basin, located on the bank above the area where the gabion and cottonwood willow community would be.

7. Flecha Caida Gabion South: This gabion would be located on the south bank of the Rillito, slightly across and slightly downstream from Flecha Caida Wash. It would protect an area of scrub/shrub vegetation.

8. Flecha Caida Gabion North: Located on the north bank of the Rillito, this gabion would be slightly upstream from Flecha Caida Wash, and would protect an area of scrub/shrub vegetation. The scrub/shrub community protected by this gabion would benefit from the water harvesting efforts of the Flecha Caida Basin, which would have weep holes that would supply water to this scrub/shrub community.

9. Alamo Wash Gabion: This gabion would be located along the south bank of the Rillito, slightly downstream from Alamo Wash. It would protect a cottonwood willow community, located just below the Swan to Alamo Basin. This cottonwood willow community would receive water via the weep holes in the Swan to Alamo Basin.

10. Hill Farm Gabion South: This gabion would be located on the south bank of the Rillito, across from Hill Farm Wash. It would protect an area of scrub/shrub vegetation, that grades into a cottonwood willow community.

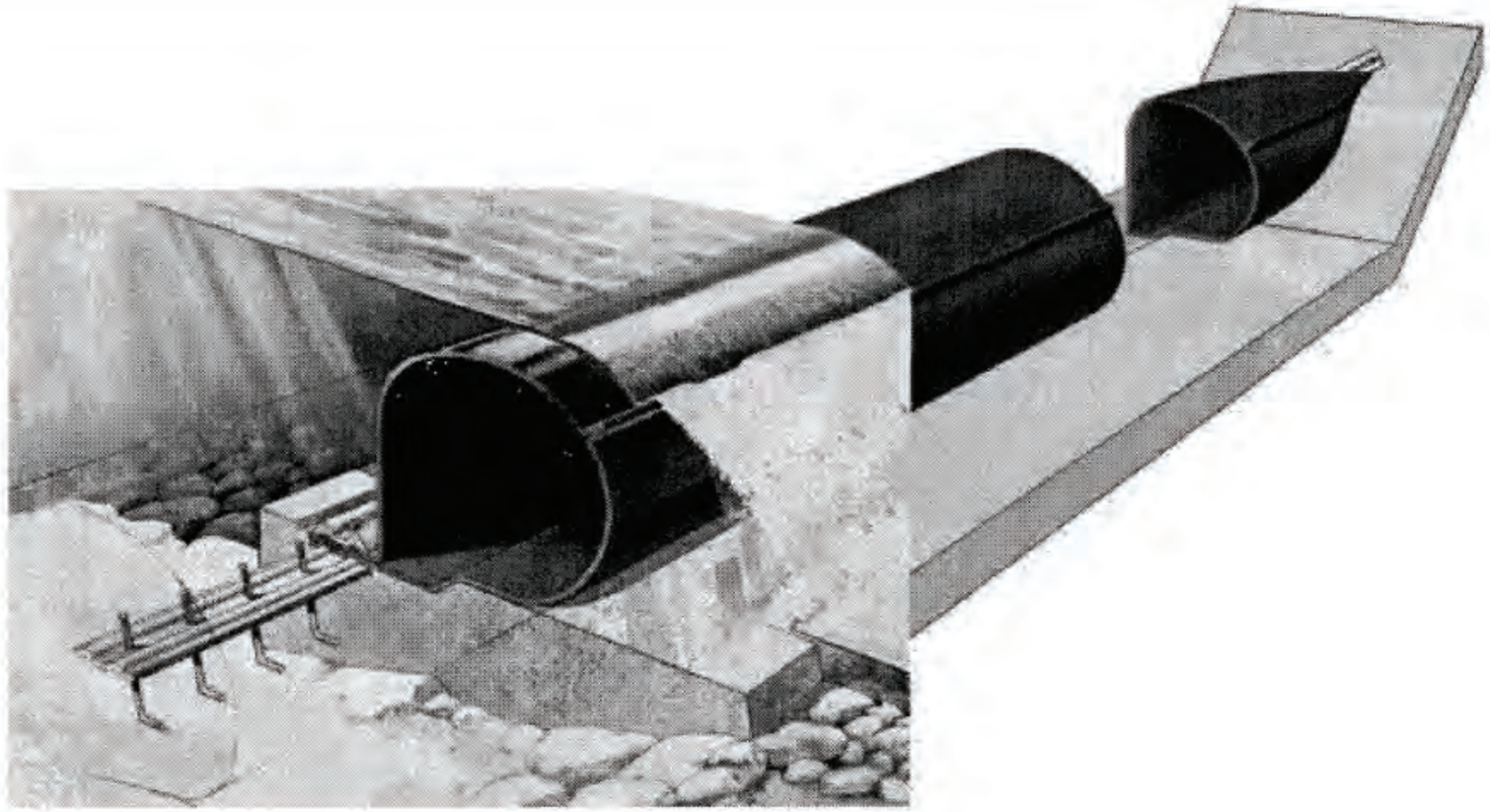
11. Hill Farm Gabion North: This gabion would be located along the north bank of the Rillito, by Hill Farm Wash. It would be the longest of the gabions, providing protection for a rather long scrub/shrub community. The Hill Farm basin would capture water that would seep out of the weep holes, providing water to the scrub/shrub community in the river bottom below the basin.

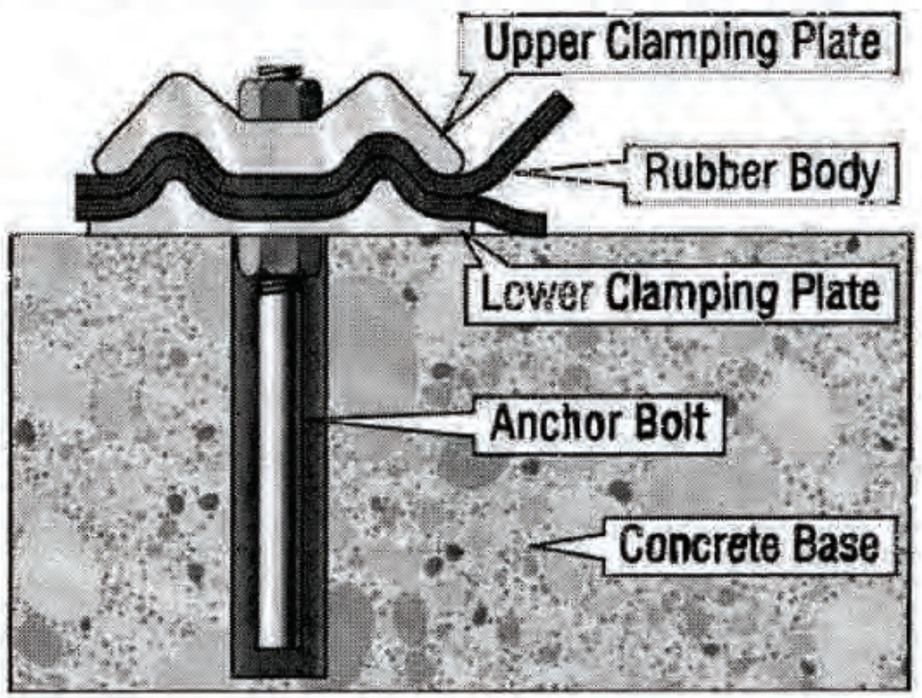
12. Craycroft Gabion: This gabion would be located along the north bank of the Rillito, right by Craycroft Wash, at the confluence of Tanque Verde Creek and Pantano Wash, where the Rillito is formed. This gabion would protect a cottonwood willow community in the area where Craycroft Wash joins the Rillito. Craycroft basin would be the source of water for the cottonwood willow community.

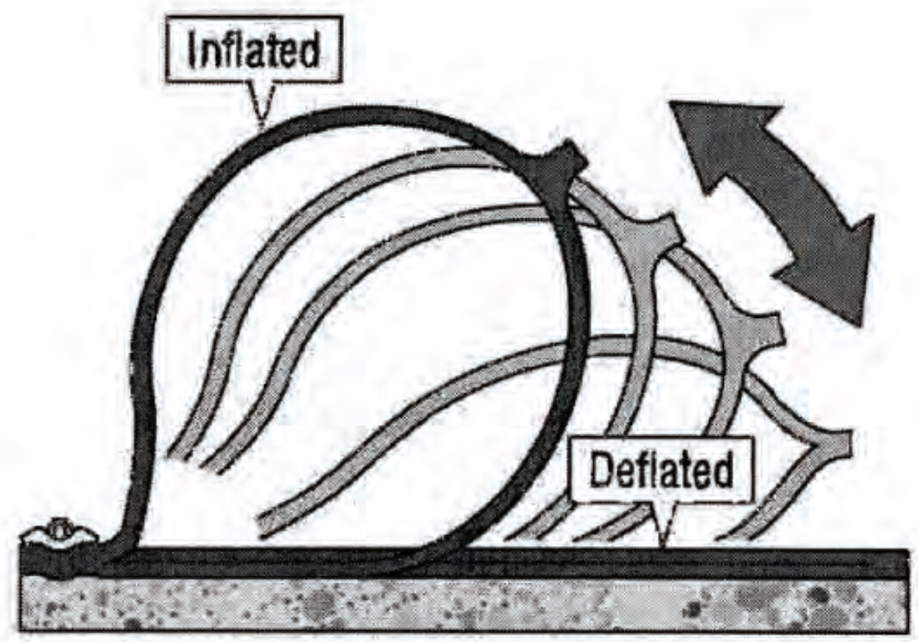
3.2.3.7 Inflatable Barriers

Inflatable barriers focus on restoring and enhancing vegetation communities in the river channel (Figure 3-7). Inflatable barriers would be installed near existing grade control structures in the Rillito. The existing concrete grade control structures along the river bottom in the upper reach of the Rillito River would be modified with secured pairs of inflatable barriers (dams) with openings at the current low flow channel locations. This would help to maintain the low flow channel location, direct flow away from establishing channel vegetation, create a meandering lower velocity channel in the sandy bottom and slow lower flows down to potentially hydrate channel vegetation. While the gabions would be aligned at an approximately 45-degree angle with the riverbank, the inflatable barriers would have a 90-degree angle with the riverbank. This 90-degree angle would function to create a slightly better backwater area where restored vegetation communities would grow. Restored vegetation communities of scrub/shrub and some cottonwood willow would be located behind these inflatable barriers for protection, and to maximize the availability of water. The height of the inflatable barriers would be approximately three feet and would automatically deflate and fold downward when flows reach the 10-year flood event level. A total of five inflatable barriers would be placed near three grade control structures in the river bottom:

1. Christopher City Wash Inflatable Barrier North: This inflatable barrier would be located on the north bank of the Rillito. It would be shorter in length than its counter part, Christopher City Wash inflatable barrier south, on the south bank of the Rillito. This barrier would protect cottonwood willow vegetation.







Source: USACE, 2002

FIGURE 3-7

Inflatable Barrier (Rubber Dam)

2. Christopher City Wash Inflatable Barrier South: This inflatable barrier would be located on the south bank of the Rillito. It would be approximately twice as long as its counter part, Christopher City Wash inflatable barrier north, on the north bank of the Rillito. This barrier would protect a cottonwood willow community that would benefit from the water seeping out of the Christopher City Wash Basin.

3. Flecha Caida Inflatable Barrier: This inflatable barrier would be located on the north bank of the Rillito by Flecha Caida Wash. There would only be one inflatable barrier at this location. It would be located in communities of river bottom (emergent vegetation) and scrub/shrub vegetation. The vegetation communities would receive water from the Flecha Caida basins that would have weep holes to drain water.

4. Alamo Wash Inflatable Barrier North: This inflatable barrier would be located on the north bank of the Rillito, across and slightly upstream from Alamo Wash. It would extend approximately on third of the way across the river channel, and protect scrub/shrub as well as cottonwood willow communities.

5. Alamo Wash Inflatable Barrier South: This inflatable barrier would be located on the south bank of the Rillito, directly across from Alamo Wash inflatable barrier north, slightly upstream from Alamo Wash. It would protect a scrub/shrub community that would receive water through weep holes in the Alamo Wash Basin.

3.2.3.8 Plant Communities

The El Rio Antiguo study focuses on the restoration of the Rillito River, in particular, the restoration of riverine communities such as mesquite forest, cottonwood willow forests, scrub/shrub, and river bottom. This restoration project focuses on the protection, improvement, and the creation of new habitat areas. The four plant communities are briefly described below, along with approximate estimates of how many acres of each community would be created under the three original alternatives, and rough estimates of costs. Location of restored vegetation communities was decided after evaluation and contemplation of hydraulic, biologic, and historic considerations. Locations identified for restored vegetation communities were determined to have the appropriate suitable conditions that meet the biologic and hydraulic requirements. Prior to implementation of restoration activities, an assessment of the proposed plant assemblages and seed mixes would be reviewed to evaluate suitability for establishment and regeneration of native vegetation.

a. Mesquite Forest Communities

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. The interior of mesquite bosques are characteristically open with an herbaceous understory of annual and perennial grasses such as vine mesquite (*Panicum obrosum*), forbs, vines, and saltbushes (*Atriplex* spp.).

Restored mesquite communities were planned for locations that historically were once abundant with mesquite bosques, as well as compatible soils, and areas that would receive the required hydraulic conditions. Restored mesquite areas were concentrated in the historic floodplain area, and in some basins. At these locations, the hydraulic and biological requirements are suitable. Mesquites require periodic inundation, less frequently than cottonwood willow communities. The root of mesquite trees are able to extend to groundwater depths of approximately 30 feet or more. The groundwater depth in the eastern half of the study area is more suited for long-term establishment of mesquite communities.

Under the basins alternative, approximately 180 acres of mesquite forest would be created. The existing mesquite forest in the study area would likely be improved with plantings. The terrace alternative would plant approximately 150 acres of mesquite forest, while the channel/tributary alternative would create approximately 170 acres of new mesquite forest.

General cost estimates for mesquite communities include approximately $12,000 an acre for plants, and $4,000 an acre for irrigation. Typical vegetation that would be planted in a mesquite community includes mesquite, desert willow, blue palo verde, wolfberry, graythorn, and hackberry. Costs of plants would be approximately $25 each (planted) for five-gallon plants, $75 each (planted) for 15-gallon trees, and about 10 cents a square foot for grasses.

b. Cottonwood Willow Forest Communities

Cottonwood-willow riparian forests are similar to mesquite forests in that they are winter deciduous vegetation communities that are largely restricted to floodplains of perennial or spring-slowing streams where they are maintained by winter-spring flooding. These western tropic-subtropic forests are restricted to the lower Colorado River and Arizona Upland subdivisions of the Sonoran Desert as both areas possess watersheds with ample winter precipitation and spring discharges to sustain them (Brown 1994). These once extensive communities, indicators of shallow groundwater areas, are now reduced to isolated pockets. This has been due to significant drops in the water table, both localized and on a regional scale, and has been accelerated by ongoing drought conditions.

Restored cottonwood willow communities are planned for suitable locations that meet the biologic and hydraulic requirements. In general, restored cottonwood willow communities are located around existing cottonwood communities, in basins, and in appropriate locations in the river channel. Locations in the river channel would receive the required water and frequent periodic inundation. Many locations of restored cottonwood are situated to maximize the availability of water, such as in the channel by basins, where the water draining from the basins would be directed to the cottonwoods (scrub/shrub also), and in areas along the river bank where channels or natural contours in the land would direct runoff to the thirsty cottonwood areas. These restored cottonwood areas are concentrated in areas where they were historically abundant. At these locations, the hydraulic and biological requirements are suitable.

The basins alternative would include approximately 100 acres of cottonwood forest communities. The terrace alternative would plant approximately 62 acres, while the channel/tributary restoration alternative would plant almost 80 acres. In all alternatives, the existing cottonwood willow communities in the study area (about three acres) would be improved with additional plantings.

General cost estimates for newly created cottonwood willow communities would be around $13,000 per acre for plants, and $4,000 per acre for irrigation. Typical vegetation that would be planted included Fremont cottonwood, Gooding's willow, sycamore, ash, Arizona walnut, and hackberry. The cottonwood willow vegetation would require approximately eight and a half acre-feet of water per year for each acre. Costs of plants would be around $75 each (planted) for 15-gallon trees, $25 each (planted) for five-gallon plants, and 10 cents per square foot for grasses.

c. Scrub/Shrub Communities

Sonoran interior strand, or the vegetation occurring within stream channels, typically supports open stands of scrub, shrubs, grasses and weeds and is therefore commonly referred to as the scrub/shrub community. Wetter sites may support more herbaceous species, such as cocklebur (*Xanthium strumarium*), canyon ragweed (*Ambrosia ambrosioides*, *Franseria ambrosioides*) and rabbit's foot grass (*Polypogon monspeliensis*). The scrub/shrub community is determined by the fluctuations of water level, incidental stormwater and runoff and scouring by flood events. Restored scrub/shrub communities are typically located in the river channel, and in the case of terraces, in the lowest terrace. Biologically, scrub/shrub communities require more water and more frequent inundation than cottonwood willow or mesquite communities. Historically, restored scrub/shrub communities are planned for areas in the river channel where they once occurred abundantly. Therefore, the planned location for restored scrub/shrub communities in the riverbed, particularly on sandbars and by tributary washed and basins that would drain water, is ideal.

The basins alternative would plant approximately 74 acres of scrub/shrub vegetation. The terrace alternative would plant approximately 22 acres, while the channel/tributary restoration alternative would create almost 60 acres.

General cost estimates for scrub/shrub communities would be approximately $20,500 per acre for plants, and $4,200 per acre for irrigation. Typical vegetation that would be planted includes wolfberry, graythorn, hackberry (at the upper edge), seep willow, bursage, and saltbush. This scrub/shrub vegetation would require approximately three acre-feet of water per year for each acre. Costs of plants would be approximately $25 each (planted) for five-gallon plants.

d. River Bottom

The river bottom consists of the open sandy aggregate areas and the mostly unvegetated low flow channel of the Rillito River. Sparse vegetation, typically saltgrass (*Distichlis spicata*), occurs in the river bottom, along with other emergent grasses and debris including coarse and fine woody debris. A few areas of restored river bottom emergent communities are planned for suitable locations. These locations are in the tributary washes along the river channel. These areas would receive the required water and protection to provide for a restored emergent community.

The basins alternative would plant approximately 12 acres of new river bottom communities. The channel/tributary restoration alternative would plant seven acres of river bottom. The terrace alternatives (the original terrace alternatives, with no gabions) would not create any river bottom vegetation areas in the river channel. However, the terrace alternatives with gabions would plants approximately 12 acres of river bottom vegetation. Many of the newly created river bottom cienega communities would be created in the tributary areas where the tributaries join the Rillito.

Rough cost estimates for creating river bottom vegetation communities are approximately $500 per acre. Typical plants that would be planted in river bottom communities include sacaton, gramas, muhly, and saltgrass vegetation. Cost estimates are roughly 10 cents per acre for grasses. Estimated irrigation costs are zero, since these communities would probably not be irrigated since they would receive enough water to sustain from normal rainfall.

e. Buffer Areas

Buffer areas are existing or potentially created lands that protect the riparian vegetation from human disturbance. For example, the existing 50-foot-wide river park on both sides of the riverbank provides a buffer to the in-channel vegetation. County parks in the area also buffer the river from human encroachment. Vacant vegetated lands, such as areas with creosote, acacia, and sparse mesquite canopy function as buffer, even where the associated biological values are considered to be relatively low. In appropriate and

available areas, the alternative plans would acquire properties that would function well as buffer. However, due to the residential nature of the study area, most surrounding areas are already, or would be developed. This should not imply that these potential human influences diminish the value of this restoration study, rather, this restoration study provides the opportunity to restore an ecosystem that has persisted under human influence and alternative, and provides an ideal opportunity for ecosystem restoration and the ability to provide an important corridor link for wildlife as well as ecosystem processes and functions. The value of this potential ecosystem restoration study should not be overlooked, diminished, or compromised because of the surrounding human landscape. The future wildlife that would be expected to occur and use the study area is typically not significantly sensitive to human influence.

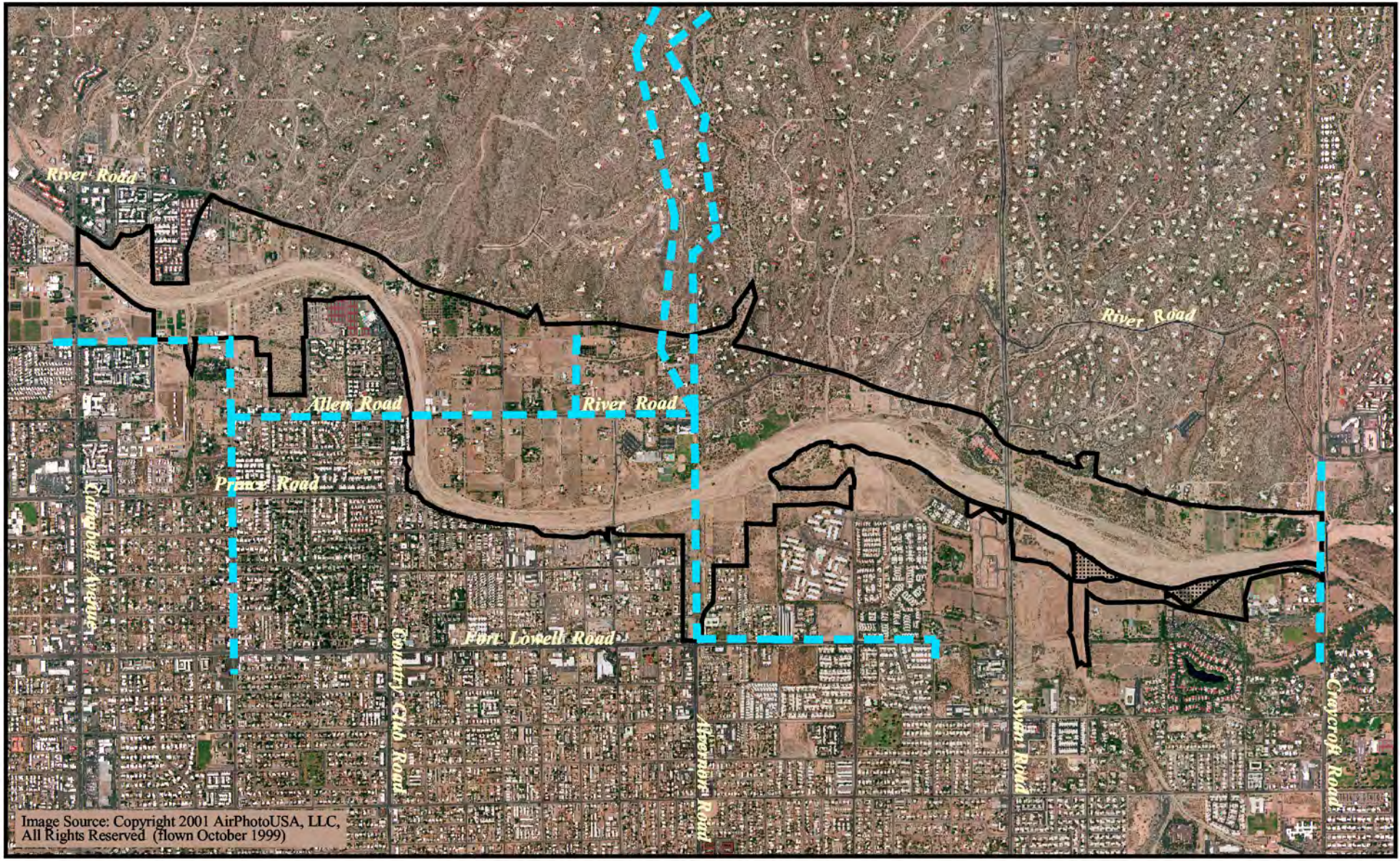
The amount of buffer planted under the alternatives varies from 0 to approximately 70 acres. Half of the alternatives plant vegetated buffer areas around 30 to 40 acres. Under the alternatives that create vegetated buffer areas, they would also improve the existing buffer with native plants.

Cost estimates for creating vegetated buffer areas are approximately $10,500 per acre. It is estimated that these plantings would require around three acre-feet of water per year per acre. Typical plants would include palo verde, whitethorn, catclaw acacia, and brittlebush. Five-gallon plants would cost around $25 (planted) and grasses would cost 10 cents per square foot.

3.2.3.9 Additional Water Sources

The newly planted vegetation communities would likely need a source of water to be sustained initially, while some would become successfully established, some others may require further additional water for a longer period. One source of additional water is reclaimed water. Reclaimed water would be accessed from existing reclaimed waterlines (shown in Figure 3-8) and would be distributed through irrigation canal systems in the Binghampton area to serve plantings in the bend area basin(s) and elsewhere. These small-scale canals would be designed to emulate the form, character, and possibly the alignment of the historic canals built by early Mormon settlers of the Binghampton area. This irrigation system will use flood irrigation (most commonly seen in agricultural settings) and direct the water through the plants using a system of swales and berms. The cultural landscape will be maintained by using Mormon ditch style irrigation through Binghampton to bend area terracing.

Flood flows beginning with the two-year event will be directed behind the soil cement below Craycroft through a pipe and ditch system stabilized with vegetation. This system will inundate the existing and restored vegetation between Craycroft and Swan Roads. Design details are included in the Design Appendix to the main report.



El Rio Antiguo study area

Not included in El Rio Antiguo study area

Reclaimed water lines
(Source: USACE and Pima County, 2001)

N 0 Miles 0.45

FIGURE 3-8
Reclaimed Water Lines

M:\jobs2\3640\env\gis\F4_ch3.apr\fig3-8 (reclaim) 12/05/02

A water budget was prepared for each alternative. Consumption was not projected for river bottom areas (cienegas) because it is assumed that this vegetation community will only occur seasonally in response to the presence of harvested storm water.

Currently, the total annual volume of secondary effluent produced at the nearby treatment plants is 74,000 acre-feet (28,000 acre-feet at Ina Road plant and 46,000 acre-feet at the Roger Road plant). Surface water sources available from the Rillito (average annual volume of 10,135 acre-feet) and tributaries (2,844 acre-feet) represent potential supplemental water sources. However, given the variability of seasonal or monthly flows, the actual surface water available in any given month can vary from zero to volumes in excess of what could be harvested. Due to the variability, irrigation systems have been designed with enough flexibility to meet all consumptive needs of the vegetation.

3.2.3.10 Craycroft to Swan Pipe and Ditch Irrigation System

This measure allows flood flows from the Rillito and from small foothill basins to be used in the lower elevation areas behind the soil cement between Craycroft Road and Swan Road on the north bank of the river. A culvert and pipe system will be constructed through the soil cement at the two-year event flow level. Using gravity pressure through the pipe, the water will flow into a one-foot deep ditch and then be allowed to overflow through a system of berms and swales across the proposed restoration areas of cottonwood willow forest and mesquite bosque. Excessive flows will drain through the existing culvert under Swan Road and out into the Rillito at the confluence with Flecha Caida Wash. This measure will improve ecosystem function by providing flood flows to additional portions of the floodplain that were cut from the Rillito by construction of soil cement bank stabilization. It will also decrease depth to saturated sediment in the area, increase the flood prone area, detain nutrients, increase micro topographic relief, allow the area to support additional plant communities, and increase habitat areas for wildlife.

3.2.4 The Original Three Preliminary Alternatives

The three preliminary alternatives originally developed focus on a particular measure:

- Basin Alternatives
- Terrace Alternatives
- Channel/Tributary Restoration Alternatives

The “basins” alternative focuses on the implementation of basins in the bend area. The “terrace” alternative focuses on terraces in the bend area. The terraces would be configured to widen the floodplain and have restored vegetation communities on each terrace. The “channel restoration” alternative focuses on channel restoration using

inflatable barriers and gabions that would direct low flow and protect restored vegetation communities. The following three sections describes how these original three preliminary alternatives were expanded and modified, then winnowed for analysis, and resulted in the final array of alternatives.

3.2.5 The Expansion of Three Preliminary Alternatives into 44 Alternatives

As part of the alternative evaluation procedure, the three original preliminary alternatives were assessed using an ecosystem functional assessment procedure. A brief discussion of the ecosystem functional assessment can be found in Section 4.3, Biological Resources; for additional details, please refer to the El Rio Antiguo main report, or a complete discussion can be found in the El Rio Antiguo Functional Assessment Procedure report (Appendix K to the El Rio Antiguo main report). As part of the ecosystem functional analysis, the original three preliminary alternatives were expanded to consider the full spectrum of how particular measures could be combined and implemented. For example, the measure of one basin in the bend area was expanded to consider the possibility of having two basins in the bend area. The same process applied to terraces in the bend area. The original terrace alternative does not have any channel restoration measures. The process of expanding the alternatives lead to the inclusion of including gabions for channel restoration in the terrace alternatives. This first round of expanding the original three preliminary alternatives resulted in 11 alternatives.

Next, the second round of alternative expansion focused on the role of buffer areas, or areas intended to minimize human disturbance. For each alternative, there were two types of buffer to consider, first there was the possibility of creating new buffer, which means conversion of a land use into a native vegetation community. This typically involves conversion of agriculture or disturbed areas into a native vegetation community and usually would involve the purchase of real estate. The other option for new buffer is not to create any and therefore purchasing real estate would probably not be needed. The second type of buffer to consider is the existing areas of buffer in the study area. The most prominent buffer is the linear river park that lines both banks of the Rillito. There are two possibilities for existing buffer. First, it could be improved by planting native plants. Second, no improvement actions would be implemented. Given the combination of a total of four actions for two types of buffer, four possible actions regarding the buffer resulted:

1. No creation of new buffer areas, and no improvement of existing buffer areas
2. Creation of new buffer areas, and no improvement of existing buffer areas
3. No creation of new buffer areas, and improvement of existing buffer areas
4. Creation of new buffer areas, and improvement of existing buffer areas

When considering the four possible actions for the buffer, the 11 alternatives were expanded to 44 during this second round of alternative expansion. Table 3-1 shows a table of the 44 alternatives. A naming convention, [alternative code]-1, or 4, indicates the buffer action based on the descriptions above. For example, an alternative ending in a "-1" means that no new buffer was created, and there was no improvement of existing buffer. Some alternatives listed in Table 3-1 are crossed out, which means that they were eventually eliminated from the ecosystem functional analysis procedure. This process of elimination is discussed in the next section.

3.2.6 Alternatives Eliminated from Further Consideration

During the next phase of alternative evaluation, 24 alternatives were eliminated from further consideration. First, the channel restoration alternative that has 12 gabions and no inflatable barriers (CHANGAB) was eliminated because it is the same as the alternative that has upstream basins and 12 gabions (UPBASINS). Next, when considering the range of actions concerning the buffer, the decision was made to focus on the alternatives that "did nothing" or "did everything" regarding the buffer. Focusing these alternatives would allow for a better comparison of the effect that the buffer decisions would have on the alternatives. The 20 alternatives that were eliminated either created new buffer areas, but did not improve existing buffer areas, or they improved existing buffer, but did not create any new buffer areas. These possible actions regarding buffer may have the tendency to minimize the differences between these alternatives in the overall functional assessment. Therefore, the ecosystem functional assessment concentrated on analyzing the alternatives on the ends of the buffer spectrum. The elimination of the 20 alternatives in the middle of the buffer spectrum made it possible to focus on the alternative analysis on the potential effect of buffer actions regarding creating and improving buffer areas. Many of the alternatives have similar measures; for example, most of the alternatives include 8 upstream basins. The consideration of buffer actions, and the elimination of 20 alternatives based on buffer actions, enabled the alternative evaluation to focus on the differences in alternative measures, not just buffer actions. After the elimination of the 4 channel restoration alternatives with 12 gabions, and 20 alternatives for buffer reasons, 20 alternatives remained for the ecosystem functional assessment.

3.3 Twenty Alternatives Selected for Evaluation

Twenty alternatives were selected to be included in the ecosystem functional assessment. Table 3-2 lists a matrix of these 20 alternatives and corresponding measures. For a more detailed discussion of the 20 alternatives evaluated in the ecosystem functional

TABLE 3-1
ALTERNATIVES MATRIX (40 ALTERNATIVES)

Buffer	Existing New	No Change No Creation	No Change Create	Restore No Creation	Restore Create
Basins					
	Upstream	Upbasins 1	~~Upbasins 2~~	~~Upbasins 3~~	Upbasins 4
	Downstream	1 Dwnbasins 1	~~1 Dwnbasins 2~~	~~1 Dwnbasins 3~~	1 Dwnbasins 4
		2 Dwnbasins 1	~~2 Dwnbasins 2~~	~~2 Dwnbasins 3~~	2 Dwnbasins 4
	All	Allbasins 1	~~Allbasins 2~~	~~Allbasins 3~~	Allbasins 4
In-Channel	Upstream Basin Alternatives with 3 Inflatable Barriers (+ 8 Gabions) and more extensive In-channel work A = Finger Rock Wash work included B =Finger Rock Wash work not included	Chanbar 1a	~~Chanbar 2A~~	~~Chanbar 3A~~	Chanbar 4A
		Chanbar 1b	~~Chanbar 2B~~	~~Chanbar 3B~~	Chanbar 4B
	0 Inflatable Barriers (+ 12 Gabions)	~~Changab 1~~	~~Changab 2~~	~~Changab 3~~	~~Changab 4~~
Terraces	1 Set (x total ft)	1 Terrace 1	~~1 Terrace 2~~	~~1 Terrace 3~~	1 Terrace 4
	2 Sets (x total ft)	2 Terrace 1	~~2 Terrace 2~~	~~2 Terrace 3~~	2 Terrace 4
Terraces & In-Channel	1 Set (x total ft) & 12 Gabions	1 Terrgab 1	~~1 Terrgab 2~~	~~1 Terrgab 3~~	1 Terrgab 4
	2 Sets (x total ft) & 12 Gabions	2 Terrgab 1	~~2 Terrgab 2~~	~~2 Terrgab 3~~	2 Terrgab 4

NOTE: Changab alternatives 1-4 are identical to Upbasins 1-4A alternatives; therefore, Changab alternatives do not need to be evaluated separately.

TABLE 3-2
ALTERNATIVES AND MEASURES MATRIX

Measures	Alternatives																			
	Alternative 1a: All Basins 4	Alternative 1b: All Basins 1	Alternative 1c: Upstream Basins 4	Alternative 1d: Upstream Basins 1	Alternative 1e: 1 Downstream Basin 4	Alternative 1f: 1 Downstream Basin 4	Alternative 1g: 2 Downstream Basins 4	Alternative 1h: 2 Downstream Basins 1	Alternative 2a: 1 Terrace 4	Alternative 2b: 1 Terrace 1	Alternative 2c: 2 Terrace 4	Alternative 2d: 2 Terrace 1	Alternative 2e: 1 Terrace with Gabions 4	Alternative 2f: 1 Terrace with Gabions 1	Alternative 2g: 2 Terraces with Gabions 4	Alternative 2h: 2 Terraces with Gabions 1	Alternative 3a: Channel Restoration with Barriers and Finger Rock Wash Channels 4a	Alternative 3b: Channel Restoration with Barriers and Finger Rock Wash Channels 1a	Alternative 3c: Channel Restoration with Barriers 4b	Alternative 3d: Channel Restoration with Barriers 1b
Basins																				
1. One Basin in Bend	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Two Basins in Bend	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
3. Dodge Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
4. Alvernon Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
5. Christopher City Wash Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
6. Flecha Caida Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
7. Swan to Alamo Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
8. Alamo Wash Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
9. Bosque Creek Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
10. Hill Farm Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
11. Craycroft Basin	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
Flow Channels																				
12. Low Flow Channel	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	-
13. High Flow Channel	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	-
14. Remnant Irrigation Channel	x	x	x	x	x	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-
Terraces																				
15. 1 set of Terraces	-	-	-	-	-	-	-	-	x	x	-	-	x	x	-	-	-	-	-	-
16. 2 sets of Terraces	-	-	-	-	-	-	-	-	-	-	x	x	-	-	x	x	-	-	-	-
Channel Restoration																				
17. Camino Real Wash Gabion	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
18. Christmas Wash Gabion North	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
19. Christmas Wash Gabion South	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
20. Country Club Wash Gabion	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
21. Finger Rock Wash Gabion	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
22. Christopher City Wash Gabion	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	-	-	-	-
23. Flecha Caida Gabion South	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	-	-	-	-
24. Flecha Caida Gabion North	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	-	-	-	-
25. Alamo Wash Gabion	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
26. Hill Farm Gabion South	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	-	-	-	-
27. Hill Farm Gabion North	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	-	-	-	-
28. Craycroft Gabion	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x	x	x	x	x
29. Christopher City Wash Inflatable Barrier North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
30. Christopher City Wash Inflatable Barrier South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
31. Flecha Caida Inflatable Barrier	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
32. Alamo Wash Inflatable Barrier North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
33. Alamo Wash Inflatable Barrier South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
Buffer																				
34. New Buffer Created and Existing Buffer Enhanced	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-
35. No New Buffer Created, No Existing Enhancement	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x	-	x

assessment procedure, please see the El Rio Antiguo main report and the El Rio Antiguo Functional Assessment Procedure report (Appendix K to the El Rio Antiguo main report).

3.4 Sorting Out the Alternative Evaluations

The selection of alternative plans for the final array required a combination of decision-making factors. For ecosystem restoration, the decision-making process attempts to incorporate human needs and values with the best understanding of the natural environment, while also recognizing a complex blend of social, economic, political, and scientific information. Both quantitative and qualitative information is used including information about outputs, costs, significance, acceptability, completeness, effectiveness, partnership context, and reasonableness of cost, as well as USACE policy and guidance screening criteria. Evaluation of the alternatives involved the consideration of the alternatives' plans success in meeting planning objectives in the context of identified constraints. Factors considered include environmental, cost estimating, and economics. Other issues considered include the ecosystem functional assessment, hydraulics effects, water budget, costs, economics, and other associated evaluation criteria such as completeness, efficiency, and acceptability. For a detailed discussion of the consideration of the above-mentioned factors, please refer to the Feasibility Study main report.

In terms of effectiveness and efficiency in achieving ecosystem restoration goals and objectives, the ecosystem functional assessment identified the terrace with gabions alternatives (2E, 2F, and 2H) as having the highest level of ecological output. While Alternative 2G had a comparable level of ecosystem output with 2E, 2F and 2H, when evaluated in the context of effectiveness and efficiency, it was not considered to be as economically feasible as Alternatives 2E, 2F and 2H.

In terms of the cost analyses, the top-ranking alternative that provides the most ecosystem productivity for the dollar is Alternative 2H, 1 Terrace with Gabions 1. Alternative 2H ranked first for both CEA and ICA analysis. Alternative 2H is the fourth ranking alternative for the ecosystem functional assessment, but given the small range of output (119 to 124 AAFCU), there is not much difference between the four top ranking alternatives in terms of ecosystem productivity.

The second ranking alternative for CEA is 3D, Channel Restoration with Barriers 1b. This alternative was not in the top three ranking alternatives for ICA. In terms of the functional assessment, this alternative ranked 19th out of 20 alternatives, producing one of the lowest levels of ecosystem productivity (only 77 AAFCUs). The Study Team determined that to produce a successful ecosystem restoration project, the minimum amount of desirable ecosystem productivity level, in terms of the functional assessment,

is 85 AAFCUs. There is concern that Alternative 3D would produce such low levels of ecosystem productivity that the ecosystem functions would only be at a poor to moderate level after implementation of intense restoration efforts. Alternative 3D may rank second in terms of CEA; however, it is not likely to produce a restored ecosystem that is viable and sustainable in the future. In terms of quality, Alternative 3D would not result in a sustainable riparian ecosystem. In terms of quantity, Alternative 3D would not provide as much vegetation communities and habitat acres as the other top ranking alternatives (2E, 2F, and 2H). Because of the limited amount of restored vegetation communities and habitat, Alternative 3D would not provide the critical corridors within and outside the study area. Alternative 3D lacks the Finger Rock Wash channels that provide important habitat and connections to areas beyond the study area boundaries. In addition, this lack of habitat limits the areas available to species during times when the vegetation in the channels would be growing back after periods of heavy rain. Despite the second place ranking of Alternative 3D in the CEA analysis, when considering the needs for a successful ecosystem restoration in terms of biological resources and the functional assessment results, Alternative 3D was not a good alternative to carry forward in the final array of alternatives.

The third ranking alternative for CEA analysis is 2F, 2 Terraces with Gabions 1. This plan also ranked second for the ICA analysis. For the ecosystem functional assessment, this alternative ranked third. The third ranking alternative for the ICA analysis is 2E, 2 Terraces with Gabions. These alternatives, 2F and 2E, also ranked within the top four in terms of the functional assessment for ecosystem productivity. Any of these plans would result in a viable, sustainable restored ecosystem.

In summary, the top ranking plans (with the exception of Alternative 3D), for the ecosystem functional assessment, CEA, and ICA cost analysis, are Alternatives 2H, 2E, and 2F. In terms of ecosystem productivity, these plans are expected to produce relatively the same level of ecosystem output (119 to 124 AAFCUs). In addition, in terms of quality and quantity of habitat, particularly the arrangement of habitat areas for corridors, these alternatives provide the best possibilities for biological resources to recover, flourish, and be viable and sustainable, resulting in a successful ecosystem restoration. In terms of the cost analysis, Alternative 2H provides the best alternative for providing a high level of ecosystem productivity for the best prices. The increase in money to implement Alternative 2F or 2E is quite high; however, the subsequent increase in ecosystem productivity (in terms of AAFCUs) is quite low.

Based on the alternative evaluation procedure, three alternatives were carried forward into the final array of alternatives. These alternatives are described in the following section.

3.5 Presentation of Alternatives

This section discusses the scenarios that the future holds for the study area. The first future scenario is the no action alternative. At the other end of the spectrum, the restored ecosystem scenario, is the final array of the three alternatives.

3.5.1 No Action

The Corps of Engineers must consider the option of undertaking no action of any form as one of the alternatives necessary for compliance with NEPA. "No Action" constitutes a possible decision to implement no ecosystem restoration by the Corps at the Rillito River. Electing to take no action in the present becomes synonymous with the expectation of future conditions without the proposed project. This future projection of conditions forms the basis of comparison with and similar projection of all other alternative plans. The no action-alternative assumes that the future will bring change, despite lack of Corps' participation. A local entity may opt to undertake some project, perhaps aimed at natural ecosystem properties, but perhaps geared more toward recreational or residential development. The future without a project depends closely on all aspects of long-term planning for urban needs as they are perceived later and as conditions change.

Future development would occur in accordance with existing plans by the City of Tucson General Plan, the Pima County Comprehensive Plan Update, and the Sonoran Desert Conservation Plan. This EIS considers a 50-year planning horizon, a projected life perhaps greater than the planning horizon of other documents or community plans.

3.5.2 The Final Array of Alternatives

The final array of alternatives include 2E, 2F, and 2H. These alternatives focus on the construction of sets of terraces in combination with gabions in the river channel. Three sets of terraces would be cut in to the existing soil cement bank, with the lowest being vegetated with scrub/shrub community, the middle with cottonwood willow community, and the highest with mesquite community. This terracing in the river would widen the channel to accommodate higher flows, with the terraces being inundated during 5-, 10-, and 25-year flows. A reinforced 2:1 slope would be used between the second and third terrace and the upland side of the third terrace would be contoured up to the current height of the adjacent upland area on its boundary. The terraces would be configured in one or two sets, depending on the placement to avoid any potential impacts to cultural resources or any real estate issues. The terrace alternatives would also include the eight upstream basins, and the low and high Finger Rock channels in the bend area. These channels would capture flows from Finger Rock Wash and distribute water to the

vegetation communities on the terraces. In addition, these alternatives vary by the extent of effort taken to preserve and restore the buffer areas throughout the study area.

3.5.2.1 Alternative 2E: 2 Terraces with Gabions with New Buffer

The 2 Terraces with Gabions 4 alternative, shown in Figure 3-9, includes two sets of tiered terraces in the bend area. Mesquite, cottonwood willow, and scrub/shrub vegetation communities would be planted on the terraces. The high and low flow channels in the bend area would function to capture flows from Finger Rock Wash and distribute water to the terraces. The eight upstream basins would be constructed under this alternative. In-channel restoration efforts include the construction and placement of 12 gabions in the river channel to protect existing vegetation as well as encourage revegetation of sandbars.

For this alternative, existing buffer areas would be restored and improved with native plantings, and new buffer areas would be created.

3.5.2.2 Alternative 2F: 2 Terraces with Gabions without New Buffer

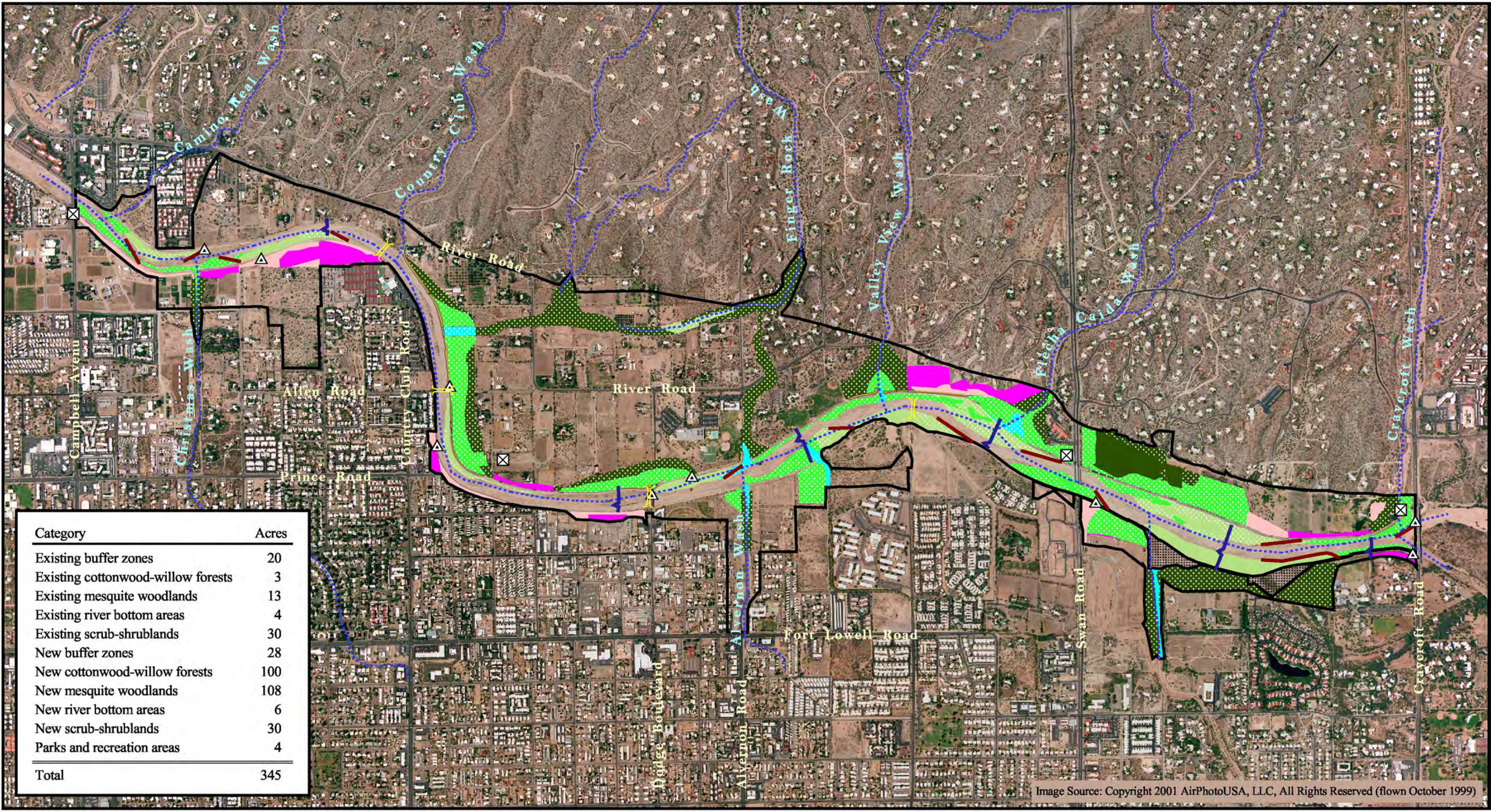
This alternative, shown in Figure 3-10, is the same as 2 Terraces with Gabions 4, except that no existing buffer areas would be improved and no new buffer areas would be created.

3.5.2.3 Alternative 2H: 1 Terrace with Gabions without New Buffer

The 1 Terrace with Gabions 1 alternative, shown in Figure 3-11, includes one set of tiered terraces in the bend area, approximately 4,300 feet in length. The three levels of the terrace would have mesquite, cottonwood willow, and scrub/shrub vegetation communities. This alternative includes the high and low flow channels that would capture flows from Ringer Rock Wash and distribute the water to the terraces. This alternative includes the eight upstream basins, as well as channel restoration measures. The 12 gabions would be placed in the river channel to protect vegetation communities and encourage revegetation. Cottonwood willow forest and scrub/shrub communities would be restored in the channel, primarily in the upstream area of the study site where the groundwater level is higher. No new buffer areas would be created and no existing buffer areas would be improved.

3.6 The Recommended Plan

After consideration of the National Objectives and other associated evaluation criteria for the El Rio Antiguo Feasibility Study, Alternative 2H (1 terrace with gabions without buffer) was selected as the recommended plan. Alternative 2H was selected because it was incrementally cost effective and efficient, and it is biologically strong with high levels of expected biological output. Alternative 2H rated first for average costs and



Category	Acres
Existing buffer zones	20
Existing cottonwood-willow forests	3
Existing mesquite woodlands	13
Existing river bottom areas	4
Existing scrub-shrublands	30
New buffer zones	28
New cottonwood-willow forests	100
New mesquite woodlands	108
New river bottom areas	6
New scrub-shrublands	30
Parks and recreation areas	4
Total	345

El Rio Antiguo study area

Not included in El Rio Antiguo study area

Rivers/Washes

Existing or proposed bridges

Access ramps

Comfort stations

Grade control

Gabion

Existing buffer zones

Existing cottonwood-willow forests

Existing mesquite woodlands

Existing river bottom areas

Existing scrub-shrublands

Parks and recreation areas

New buffer zones

New cottonwood-willow forests

New mesquite woodlands

New river bottom areas

New scrub-shrublands

(Source: USACE ERDC-EL, 2002)

N 0 Feet 1500

FIGURE 3-9

Alternative 2E: 2 Terraces with Gabions with New Buffer

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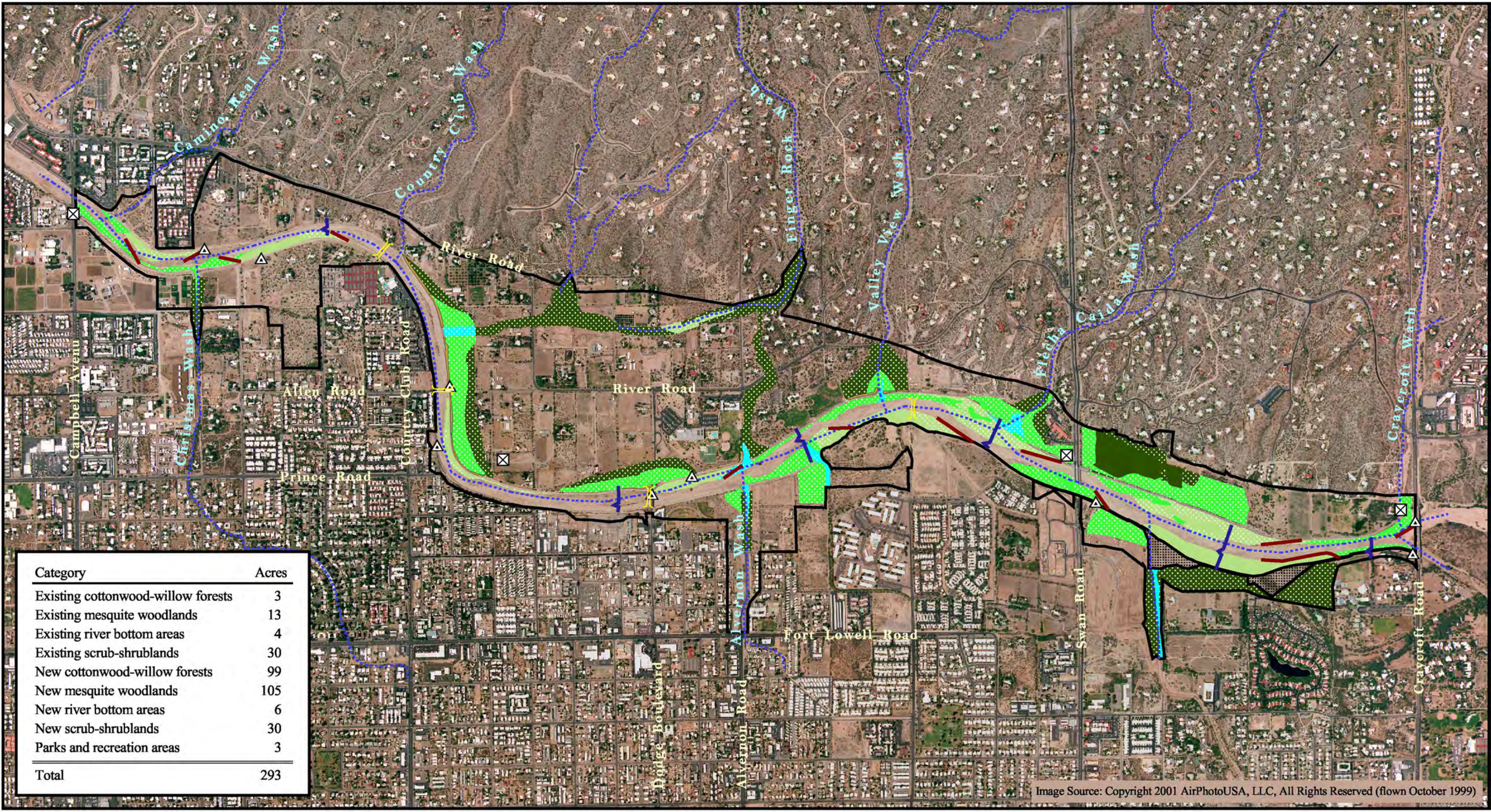

Category	Acres
Existing cottonwood-willow forests	3
Existing mesquite woodlands	13
Existing river bottom areas	4
Existing scrub-shrublands	30
New cottonwood-willow forests	99
New mesquite woodlands	105
New river bottom areas	6
New scrub-shrublands	30
Parks and recreation areas	3
Total	293

El Rio Antiguo study area

Not included in El Rio Antiguo study area

Rivers/Washes

Existing or proposed bridges

Access ramps

Comfort stations

Grade control

Gabion

Existing cottonwood-willow forests

Existing mesquite woodlands

Existing river bottom areas

Existing scrub-shrublands

Parks and recreation areas

New cottonwood-willow forests

New mesquite woodlands

New river bottom areas

New scrub-shrublands

(Source: USACE ERDC-EL, 2002)

N 0 Feet 1500

FIGURE 3-10

Alternative 2F: 2 Terraces with Gabions without New Buffer

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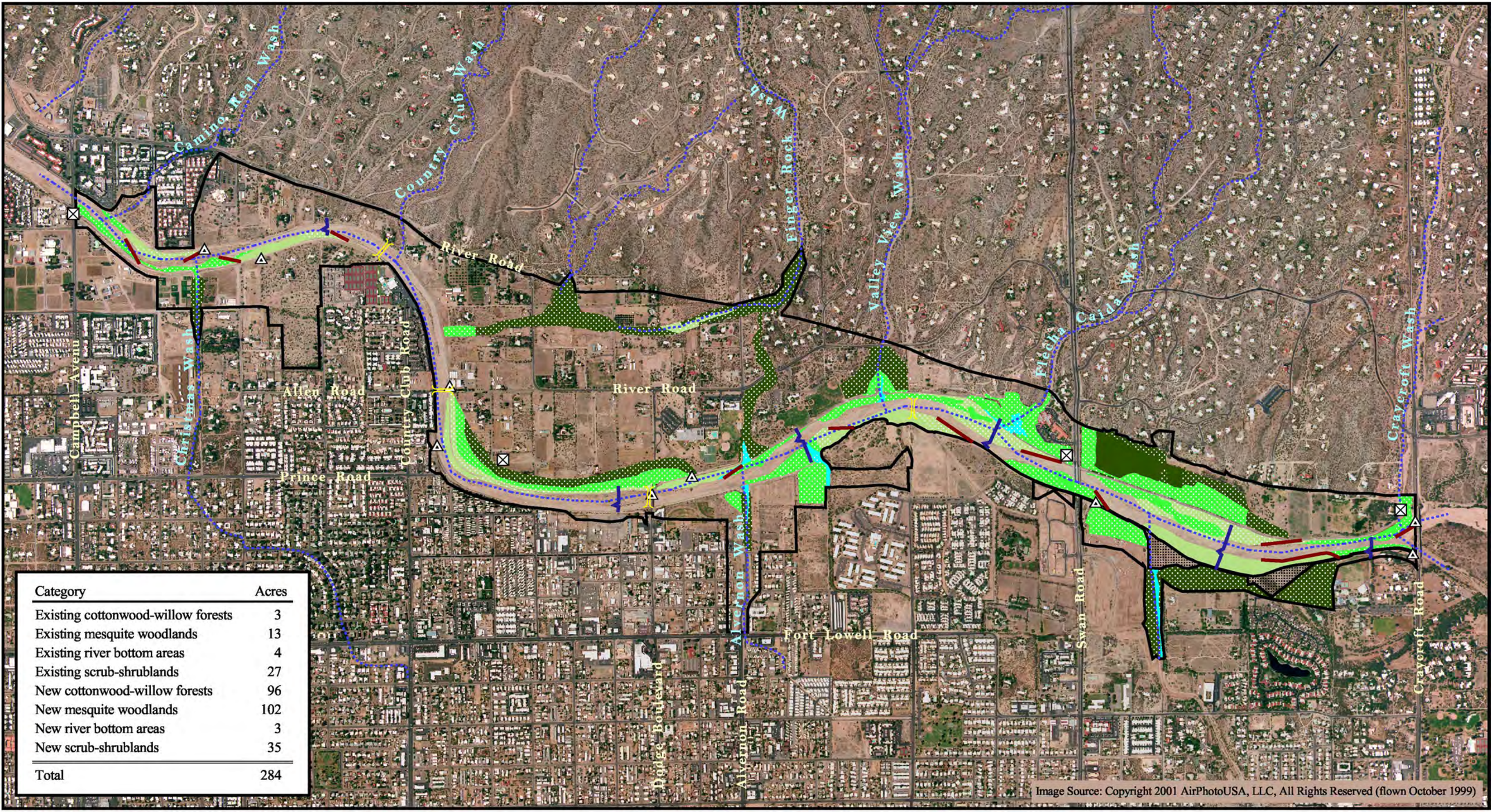


Category	Acres
Existing cottonwood-willow forests	3
Existing mesquite woodlands	13
Existing river bottom areas	4
Existing scrub-shrublands	27
New cottonwood-willow forests	96
New mesquite woodlands	102
New river bottom areas	3
New scrub-shrublands	35
Total	284

El Rio Antiguo study area

Not included in El Rio Antiguo study area

Rivers/Washes

Existing or proposed bridges

Access ramps

Comfort stations

Grade control

Gabion

Existing cottonwood-willow forests

Existing mesquite woodlands

Existing river bottom areas

Existing scrub-shrublands

New cottonwood-willow forests

New mesquite woodlands

New river bottom areas

New scrub-shrublands

(Source: USACE ERDC-EL, 2002)

N 0 Feet 1500

FIGURE 3-11

Alternative 2H: 1 Terrace with Gabions without New Buffer

M:\jobs2\3640\env\gis\F4_ch3_nov03.apr\fig3-11 (1terrgab1) 11/03/03

ICA, and fourth for biological output. In addition, Alternative 2H causes an incidental reduction of flooding cause by Finger Rock Wash. Another incidental benefit for this plan is that the recreation plan will complement the restoration plan by helping to minimize human interference and adds to the established park in a beneficial way that also promotes and protects restoration goals. Alternative 2H meets the objectives of the study sponsor, Pima County Flood Control and Transportation District. Finally, Alternative 2H appropriately addresses the balance between ecosystem restoration and the need to maintain the existing level of flood protection. For a more detailed discussion, please see the El Rio Antiguo main report.

3.7 Summary

The final array of alternatives, Alternatives 2E, 2F, and 2H, would consist of implementing terraces in the bend area, Finger Rock Wash high and low flow channels in the bend area, 12 gabions in the river channel, and basins at most of the washes where they join with the Rillito. The terraces would restore the hydrologic functions between the river channel and the terraces and provide mesquite, cottonwood, and scrub/shrub habitat. The Finger Rock Wash high and low flow channels would guide water to the Rillito and provide water to the terraces, as well as to mesquite and some scrub/shrub habitat. The gabions would facilitate and protect the establishment of vegetation, including scrub/shrub and cottonwood willow, in the river channel. The gabions would also improve the hydrologic functions by directing low flow and creating shallow backwater areas where vegetation communities would flourish. The basins would function to slow and capture the water from the washes after periods of rains. They would provide valuable cottonwood willow and mesquite habitat and improve important chemical and hydrologic functions such as increasing water absorption, nutrient cycling, and water filtration. Together, all these measures combine to maximize the hydrologic functions, improving infiltration and water availability for vegetation communities that are critical to native wildlife.

In order to fully describe the effect that the final array of alternatives would have in terms of ecosystem restoration, a conceptual future conditions scenario is shown in Figure 3-12. The before picture shows a portion of the current conditions, which are a degraded riparian ecosystem. The measures in the recommended plan will directly affect and improve the ecosystem functions, which will then result in biological resources that flourish. The after pictures in Figure 3-12 show a conceptual depiction of the extent of restored, flourishing vegetation communities and quality habitat for wildlife. For details of the connection between ecosystem functions and restored biological resources, refer to the El Rio Antiguo Ecosystem Functional Assessment Procedure: Analysis, Results, and Documentation Appendix.

Existing Condition

Future with Implementation of the Recommended Plan

FIGURE 3-12

Chapter 4.0
Affected Environment

4.1 Introduction and Physical Setting of the Rillito River and Study Area

4.1.1 Introduction

At the outset of this feasibility study, possible ideas for restoration of riparian ecosystems along desert washes and areas inundated when the Rillito River runs high were considered where appropriate throughout a study area approximately 1,070 acres in size, below the Catalina Mountains in the north-central portion of the city of Tucson in eastern Pima County, Arizona (see Figure 1-1). The majority of the acreage delineated on uplands within the study area fulfills residential needs in north Tucson. Undeveloped uplands occur mostly where washes cross the desert on their way to the Rillito River. Early in the study, opportunities for ecosystem restoration along the full length of all these washes in the study area, except Finger Rock, were judged impractical, and the Rillito became the main focus of all further considerations.

The Rillito River of 2003 came to its current form, a highly managed seasonal wash incised below historic geomorphologic grade and now entrained between sculpted banks formed of soil cement, through management of lands and water resources in the Tucson region for human purposes. Widely adopted practices to divert surface runoff for agricultural use happened about the same time as a burgeoning cattle industry caused profound changes in the plant communities of upland rangelands, the 1870s-1900s. When techniques to draw water from below the immediate surface were refined about the turn of the last century and began to provide much more water for agriculture, water tables in the Tucson region sank below the climatic hydrological connection with surface waters. As a result historically perennial streams such as the Rillito went permanently dry, except for transient flood discharges mainly during the months of July, August, and September when thunderstorms bring monsoonal rainfalls. Without that connection and interchange between groundwater and surface water year around the riparian ecosystem faltered, then vanished wholesale throughout the region. The Rillito of today has only

scattered and isolated remnant clusters of native trees and shrubs growing at spots where high bedrock forces scarce water close to the surface or where urban runoff brings a steady but marginal trickle of water into the riverbed. This feasibility study examines ways to restore a semblance of those foregone properties and attributes of a riparian ecosystem.

4.1.2 Physical Setting

The Rillito River arises at the confluence of Pantano Wash and Tanque Verde Creek, where Craycroft Road happens to cross the channel. The Rillito's watershed extends from the southeastern part of the Tucson area (essentially the eastern end of the Santa Rita Mountains and southern end of the Rincon Mountains) around to high elevations that enclose the Tucson Basin on both its eastern (the Rincons) and northern (the Catalina Mountains) sides. The Rillito heads west and a bit north of the study area to join with the Santa Cruz River approximately 12 miles downstream. The Tucson Basin itself formed as a deep structural depression aligned north to northwest in which alluvial deposits 20,000 feet thick have accumulated over geological time, part of the basin and range province of western continental landforms.

As the disconnect between surface and groundwater increased a century ago, the Rillito changed from a braided and meandering streambed with a broad floodplain to a channel morphology shaped by uncharacteristic flood discharges which scoured and incised the river. Despite the Rillito's slight gradient within the study area, 20.1 ft/mile (elevation of 2,425 feet above mean sea level (MSL) at Craycroft Road and 2,328 feet at Campbell Avenue, over 4.83 river miles), simultaneous lateral migration and downcutting have made its channel 250 feet in width and 4 to 7 feet in depth, on average. Some wide parts are as much as 600 feet. In response to historic flood events, such as record floods in October 1983 and January 1993, soil cement bank stabilization was installed along about 94 percent of its banks within the study area to control lateral channel migration. The mouths of tributaries and the south bank between Columbus Avenue and Alvernon Wash (approximately 3,000 feet) are the only lengths of the Rillito without it. The Corps built paved and gravel pedestrian trails atop the soil cement stabilization of banks along the river that are now heavily used by the public for walking, biking, jogging, and horseback riding. Seven hardened grade control structures were installed at optimum locations in the riverbed to control scouring of the toe and undercutting of the soil cement revetments on the banks. These structures induce localized aggradation of sands and other sediments—sands commonly occur as much as 12 feet deep in a wide fan upstream from the grade control structures—and considerable scour immediately behind them.

Ten washes, nine of them comparatively small, flow into the Rillito along the study area. Steeper gradients to the north cause those originating in the Santa Catalina Mountains to carry somewhat more sediment: Campbell, Camino Real, Finger Rock, Valley View,

Flecha Caida, and Craycroft Washes. Of these, Finger Rock Wash is the largest. It also has a curious linkage with the Rillito because runoff from Finger Rock Wash spreads out in its own hydrological floodplain on the north overbank of the Rillito, a region known locally as the "Bend" where the river turns abruptly north and at an elevation above its channel. Consequently, runoff from Finger Rock Wash spreads out as a sheet flow across the bend instead of running along a wash all the way to the Rillito, the more typical way of desert circumstances. Four flowing into the Rillito from the south pass through more developed parts of the Tucson metropolitan area from lesser elevations and therefore along shallower gradients: Christmas, Alvernon, Christopher City, and Alamo Washes.

4.1.3 Effects of Three Ecosystem Restoration Alternatives

In the course of characterizing the study area, fleshing out conceptual ideas for ecosystem restoration along this segment of the Rillito, and systematic screening to thin the numbers from nearly four dozen rough plans whose assorted features became virtually indistinguishable in their overall scope to a manageable count, three competing alternatives have come to the forefront. Each one would achieve roughly the same net outputs, measured by functional ecological processes essential for habitat restoration, in slightly different places between Craycroft Road and Campbell Avenue (see Figure 1-1). Each one would also modify somewhat the existing bank in the area of the bend, transform the mouth of nine separate washes joining the Rillito into locales designed for planting riparian species, restore mesquite woodlands along the outwash of Finger Rock Wash, rely temporarily on flood irrigation methods to apply reclaimed water until such time as trees and perennial shrubs could become self-sustaining and then afterward to sustain them through episodic droughts, connect the right and left banks of the Rillito by two light bridges across it, realign portions of some existing recreational paths, and change those existing path designs to accommodate both recreational and vehicular maintenance needs of an ecosystem restoration project.

Implementation of any of these three would cause changes to some aspects of the human environment. Other aspects, however, would not foreseeably differ in any measurable, or substantive, way in consequence of implementing any one of those alternatives. For these aspects of the ecosystem restoration project, the conditions expected in the future would lack any causal connection to that project itself. In other words, circumstances would be indistinguishable from future conditions even if no restoration project were implemented. Therefore, the analyses of these particular scarcely discernible foreseeable consequences, addressed over the full expected life of the project, and directly or indirectly attributable to a restoration alternative need not be lengthy or presented in the detail appropriate for those likely to alter future conditions. In the judgment of the Corps, very minor changes, or indeed none at all, would result. Consequently, the

aspects grouped below will receive a minimal presentation of existing conditions. For the El Rio Antiguo Feasibility Study, they include:

1. Topography and Geology
2. Land Use
3. Aesthetic Resources
4. Air Quality
5. Noise
6. Hazardous and Toxic Wastes
7. Socioeconomics
8. Utilities
9. Transportation
10. Safety

For these 10 topics listed above, the sections addressed include Introduction, Synopsis, and Supporting Information to direct the reader to available sources for more detailed information. In keeping with guidance by the Council on Environmental Quality (§1502.2 implementation), these 10 topics are intentionally presented very tersely and in a format different from those topics that warrant a more thorough presentation.

4.2 Quantifying Ecological Processes and Biological Resources

This feasibility study analyzes ecosystem restoration ideas proposed for environs of the Rillito River. The project includes its broad river bottom, immediate banks, small washes, and older and stabilized depositional floodplain terraces, along with biological inhabitants that make up ecological communities and riparian ecosystems of the Sonoran Desert. A few tributary washes traverse these older floodplain terraces. Other terraces, overbank floodplains created in a geological timescale, are now effectively isolated from further geological aggradation and degradation by bank stabilization methods (soil cement) already in place along most of the study area. Active floodplains are considered to be areas with hydrologic connection to the river. Biotic resources, whether plant communities or individuals of species, inherently follow these riverine patterns. Determining the value of biological resources requires a method 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 relies on results of an Ecosystem Functional Assessment Procedure (termed an EFA analysis) to yield quantitative descriptions of biological resources along and adjacent to the Rillito River, projections of changes in fundamental ecosystem processes without which ecosystem restoration itself cannot happen, and quantitative predictions of the results of implementing the proposed alternatives.

The EFA methodology of this study was adapted and modified from a numerical technique called hydrogeomorphic assessment (HGM), used increasingly often to characterize wetlands. The HGM approach for functional analyses of ecological processes in natural aquatic settings was first applied by the Corps in the permitting process required to evaluate projects in waters of the United States. HGM techniques were designed to give insights into the ecological processes that both characterize wet places and cause them to be wet places, and form the basis to determine mitigation required for impacts. Those ecological processes are treated as functional properties of ecosystems.

4.2.1 A Brief Overview of EFA and Causal Ecological Processes

The EFA method focuses on quantifiable inherent processes, the functions ecosystems carry out in nature. Those functions link and depend upon various attributes that correspond to measurable features of an ecosystem, for example, the density of tree canopy over a section of stream bank, permeability of soils which form that bank, and complexity of surface relief along that bank. These types of attributes can be measured, counted, or described concisely in a standardized way. The attributes of interest in

functional analyses of ecologically important processes nearly always have an inherent sense of quantity that affects the way they each influence the ecosystem. For example, a denser tree canopy indicates something about the numbers of trees, the longevity of mature trees and success of seedlings, water availability, soil nutrients, and the trees' overall health and vigor at a given location.

A mathematical equation is used to represent the relationships between attributes and ecosystem functions. The result of that equation becomes a way to represent a function important to the observable behavior of the ecosystem. In a way parallel to the sense of healthy trees, the combination of the functions gives a mathematical insight into the overall health and condition of the ecosystem. Consider as an example a function that expresses the ability of an ecosystem to store runoff. The ability of a specific ecosystem to perform this function may be represented by using a mathematical equation that includes seasonal runoff (a hydrologic process) from surrounding higher landforms (a geological attribute), the density of perennial shrubs along a watercourse (an ecological attribute), and the stream gradient (a geological attribute). The result of the equation, a numeric answer between 0 and 1, indicates the expected ability of the ecosystem to store runoff. "Ability" used this way matches ecosystem health and condition in the way used above; that is, quality of ecosystem process. A value of 0 would be interpreted as indicating absolutely no water storage of any kind, such as would be expected on a paved road surface which has as poor ecosystem health as possible. A value of 1 would be interpreted as indicating the best possible natural water holding features, such as would be expected in rangelands dense with native bunchgrasses, which would be counted ecologically very healthy.

Roughly speaking, the more land that may sustain basic ecological processes, especially contiguous tracts of land, the better ecosystem restoration efforts are likely to turn out. Urban settings constrain achievable ecosystem restoration results because smaller parcels, and fragmented from one another as often as not, may be the only settings available. Efforts to restore ecosystems have an inherent prospect for better values when located farther from urban conditions, or where physical separation between communities and direct influence of urban life can be minimized. Conversely, even amid urban development such as this region of the Rillito, where available lands would accommodate self-sustaining biotic communities, meaningful ecosystem restoration can be accomplished.

This study identifies and evaluates alternatives, the broad planning objectives of which would be to reestablish as many of the basic ecosystem processes as possible. The numeric results of these evaluations can actually be presented in two different numerical ways. The quality of ecosystem processes has a value of its own. This first measure represents the functional capacity index (FCI). The FCI for each ecological process characterizes how well that process is taking place. FCIs for a restoration alternative describe what degree of success in restoring those processes may be expected based on

measurements and calculations of exactly the same ecological processes at several reference sites. FCIs range between 0.0 and 1.0 in value; where an FCI = 0.6 would indicate the process is occurring at 60 percent of the maximum that could be achieved in similar circumstances. The second way expresses quality (FCI) multiplied by the area of the biotic community to give an answer measured in units of functional capacity (FCU); that is, how well the process happens and how big an area it involves. In nature, ecological conditions change within a biotic community over time, and FCUs turn out to have changing values because they reflect directly the ecological processes at work in that community over a span of time, even including the snapshot in time when all field measurements are made. The second way of presenting results then uses average annualized functional capacity units (AAFCU)—area times quality of ecological process, which itself may be changing over time. After considerable arithmetic, this method to assess ecological functions yields quantitative predictions averaged over the life of the project; for example, the acreage to be planted to cottonwood-willow would improve nutrient cycling in the Rillito by more than six times what exists there now, or the species composition, their abundance, and age structure of respective species would increase by more than 3.5 times over what exists now.

The analytical method depicts these processes as equations built with ecological attributes that were measured in nature. Measurements for reference sites were conducted upstream at relatively undisturbed locations on Tanque Verde Creek, and east of the Rincon Mountains at similarly undisturbed places on the San Pedro River. Both locations were selected on the basis of professional judgment by academic and applied ecologists highly knowledgeable about biota in the Sonoran Desert. Eleven ecosystem functions were used to characterize the Rillito for this study. They characterize three comparatively different groups of processes: those of abiotic nature which pertain to the movement of water and sediments and structural geomorphology of rivers in arid regions; those of both abiotic and biotic nature which pertain to nutrient cycles within biological communities; and those that are biotic reflecting the habitat types and quality. The eleven functions evaluated in this study are:

Hydrology and geomorphic processes (abiotic)

1. Water flowing in the Rillito shapes its bed, banks, and overbanks
2. Surface features slow flows and catch water temporarily
3. Long-term retention of water on or just below the surface
4. Percolation of water to the water table

Nutrient transport and cycling processes (abiotic and biotic)

5. Nutrient cycling within the biotic community
6. Passage of elements and carbon compounds through the community
7. Retention of particulate materials

Species interaction processes (biotic)

8. Assemblage of species
9. Spatial organization and structure of species
10. Patchiness of habitat and organisms moving within and through the plant community
11. Separation between biota and direct urban conditions

The characterization that follows (Table 4.2-1) summarizes the causes for rather low values of each process separately. It also describes how the restoration alternatives would correct, to a degree, impairment of each process and in overall effect promote a riparian community more alike that from 1880 by virtue of renewing the ecological processes responsible for a healthy ecosystem.

TABLE 4.2-1
DESCRIPTION OF EXISTING CONDITIONS,
IN TERMS OF ECOLOGICAL PROCESSES, AND ECOSYSTEM RESTORATION GOALS

Processes	Baseline Values[1] FCI	FCU	Existing Conditions	Description of Process and Ecosystem Restoration Goals
The eleven processes are grouped in three general categories.	*A description of each process follows its Functional Capacity Index and Functional Capacity Unit Values.*			*Summary of how each process is utilized in the three alternatives. These broad measures are included in all three restoration alternatives.*
HYDROLOGY AND GEOMORPHIC PROCESSES (ABIOTIC) CATEGORY				
Process No. 1 Flowing water shapes gross features	0.04	8.3	Past range and farm water excesses; incised, channelized riverbed; channel control by soil cement banks; disconnection from historic floodplain.	Terraces at the bend; intentional use of water from Finger Rock Wash; diversion of floodwater to supply mesquite upstream of Swan Road.
Process No. 2 Temporary surface water storage	0.18	40.9	Absence of any genuine surface features; little vegetation to slow and retain flows; soil cement constrains flows and hastens their passage through.	Gabions to trap sediments and moisture; trees and perennial shrubs to be planted in the channel; basins formed at tributary washes; coarse woody detritus would promote scour pockets and water retaining depressions.
Process No. 3 Long-term surface water storage	0.14	31.6	No subsurface flow of water; disruption of perennial runoff patterns.	Retention of flows increases prospects for infiltration.
Process No. 4 Percolation to water table	0.0	0.0	All of 1, 2, and 3 above.	Unlikely to influence to deep percolation.

TABLE 4.2-1
DESCRIPTION OF EXISTING CONDITIONS,
IN TERMS OF ECOLOGICAL PROCESSES, AND ECOSYSTEM RESTORATION GOALS
(continued)

Processes	Baseline Values[1] FCI	FCU	Existing Conditions	Description of Process and Ecosystem Restoration Goals
NUTRIENT TRANSPORT AND CYCLING PROCESSES (ABIOTIC AND BIOTIC) CATEGORY				
Process No. 5 Cyclical movement of nutrient within organisms	0.14	31.4	Sparse vegetation and little to no detritus.	Very large increase in trees, shrubs, and grasses.
Process No. 6 Nutrients passing through biotic communities	0.08	18.1	Disruption of perennial flows; disconnection of historic floodplain; soil cement banks limit organic input from adjacent uplands.	Basins at tributary washes to be vegetated; gabions in river bottom to create backwaters where organic detritus would collect.
Process No. 7 Physical retention of particulate materials	0.15	35.3	Uniform, featureless river bottom and soil cement cannot retain sediments and organic detritus.	Gabions and trees in riverbed to slow velocities and capture materials from upstream.
SPECIES INTERACTION PROCESSES (BIOTIC) CATEGORY				
Process No. 8 Diversity of species	0.14	32.3	Austere structural uniformity precludes reestablishment of many native species; invasive species predominate.	Deliberate planting and maintenance of desirable species; suppression of invasive alien species.
Process No. 9 Spatial organization of biotic communities	0.18	40.4	Physical uniformity fosters a single stratum of plants.	Increased organic detritus, terrace structure, and species to be planted would create three additional layers.

TABLE 4.2-1
DESCRIPTION OF EXISTING CONDITIONS,
IN TERMS OF ECOLOGICAL PROCESSES, AND ECOSYSTEM RESTORATION GOALS
(continued)

Processes	Baseline Values[1] FCI	FCU	Existing Conditions	Description of Process and Ecosystem Restoration Goals
SPECIES INTERACTION PROCESSES (BIOTIC) CATEGORY (cont.)				
Process No. 10 Habitat continuity & movement of species	0.32	74.6	High flood flows severely restrict establishment of trees and dense plant cover.	Locations, densities, and species chosen for vegetation to create larger clusters and strands of riparian habitat, increasing the connection between habitat patches.
Process No. 11 Separation from adjacent urban conditions	0.58	202.9	Future development would encroach into most of the currently unused land.	No direct features to deflect development and thereby retain “buffer” areas.

[1]Numerical results from Ecosystem Functional Assessment. Calculations appear as both functional capacity index (FCI) and functional capacity units (FCU) for each of the 11 ecological processes.

The El Rio Antiguo Ecosystem Functional Assessment was prepared as a technical report to support this study. Although not appended to this EIS study, it is available for review by request to the U.S. Army Corps of Engineers in Los Angeles. A reader who wishes a printed copy (roughly 300 pages, including many fan-folded tables and figures in color) will bear the cost of reproducing the document.

4.3 Topography and Geology

4.3.1 Introduction

In support of the Feasibility Study, a Geotechnical Appendix (Geotechnical, Appendix F to the Feasibility Study Main Report) was prepared to discuss issues relevant to the environmental restoration effort. These issues include: (1) near-surface alluvium and its geohydrology, (2) near-surface soil stability conditions and their potential to remain stable or destabilize under irrigation, and (3) potential near-surface contamination and its potential to mobilize under irrigation or impact cultivated plant species.

4.3.2 Synopsis

Runoff from the eastern portions of the Tucson area flow westward to the Santa Cruz River, through the Rillito, which is a result of the confluence of the two smaller drainages, Tanque Verde Wash and Pantano Wash. The Rillito study area is on a basin and range valley floor called the Tucson Basin, with elevations ranging from 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 thick.

As for channel morphology, the Rillito was once a braided, meandering streambed with a broad floodplain. Over the years, channel morphology has been altered and the Rillito is now an incised channel averaging 250 feet in width and four to seven feet in depth. Flooding and simultaneous lateral erosion and downcutting have increased widths to as much as 600 feet in places. Soil cement bank stabilization has been added along most of the study area. The mouths of tributaries and the area between Alamo Wash and Alvernon Wash are the only areas without soil cement for bank stabilization protection.

Potential geologic concerns in the study area include soils, particularly soils with the potential to have collapsible and expansive properties. Soils with the potential to be collapsible have been identified in the study area, and others, prone to expansive traits, also have been identified. Sand and gravel are currently being mined on the north bank of the river, inside the current study area, but not within the stream channel. There are no faults occurring within the immediate vicinity of the study area.

4.3.3 Supporting Information

This synopsis of the current topographic and geologic setting is based on the Geotechnical Appendix (Appendix F) to the Feasibility Study Main Report. This report discusses the most detailed compilation of topography and geology regarding the study area and surrounding landscape.

4.4 Hydrology and Water Resources

4.4.1 Introduction

If implemented, an ecosystem restoration project on this portion of the Rillito would occur where soil cement was previously installed to stabilize its banks. Implementation of ecosystem restoration along this region of the Rillito's bottom, sides, and select overbank areas would overlap structural features designed to hasten flood flows through the river and already in place. Hence, both engineering considerations and environmentally relevant attributes of the Rillito need to be presented in this section of existing conditions. 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 Appendixes A, B, and C, respectively, to the Feasibility Study Main Report and should be reviewed for additional information on hydrology and water quality.

4.4.2 Environmental Considerations

4.4.2.1 Groundwater

Essential characteristics of groundwater in the saturation zone close to and below that constrain or promote ecosystem restoration include its depth and hydraulic interactions with water on the surface and porous water-holding layers at greater depths. This saturation is variable due its permeability, shallow depth to groundwater, variability during flow events, and pumping of groundwater.

Infiltration of the episodic streamflows in the Rillito occurs through highly permeable stream-channel deposits. Several layers of rather porous alluvial sediments underlie the Tucson Basin. They share extensive hydraulic interconnections and combine to form the principal aquifer beneath the basin. The various sedimentary layers are mainly of loosely consolidated to moderately cemented silty sands to silty gravels and form an aquifer at least 2,000 feet thick below much of the general course of the Rillito River. Older sediments are buried deeper (the Pantano Formation of Oligocene age and the Tinaja beds of Miocene and Pliocene age). Younger alluvial layers were deposited closer to the existing land surface (the Fort Lowell Formation of Pleistocene and various near-surface deposits of Pleistocene and Holocene age). The Fort Lowell Formation typically consists of interbedded layers of clay, silt, sand, gravel, and boulders. In places this porous formation exceeds 50 ft, but generally is about 30 ft. The most permeable layer, the most recently deposited alluvium directly beneath the Rillito's channel, consists of sands,

gravels, and boulders and minor amounts of silt and clay. Thickness of individual beds averages 20 ft.

Harder and much less permeable crystalline bedrock happens to exist much closer to the surface in the general vicinity where Tanque Verde Wash and Pantano Creeks join and intrudes upward into the overlying the alluvial sediments. As a result, at the upstream limit of the project area both the groundwater table and top of the Ft. Lowell occur about 30 ft in depth below the invert of the Rillito.

In general, infiltration rates are higher in the eastern portion of the study site, by Craycroft Road. Groundwater flows down gradient to the south-southwest. Depth to groundwater in 2001 was 16 to 45 feet in the Craycroft to Alvernon reach of the study area with potential to support established riparian vegetation. The downstream reach, Alvernon to Campbell Avenue, has depth to ground water levels of 120 to 160 feet. Essentially all recharge is through sandy channel bottom with very little recharge in overbank areas. Groundwater flow continues along the ephemeral stream channel of Rillito River and eventually discharges to municipality wells south and west of the study.

Despite the permeability of sediments, the engineered hydraulic features of the channel carry runoff so quickly it does not soak in, and an estimated 5,100 to 6,800 acre-feet of annual runoff passes straight through the Rillito to the Santa Cruz River at flood speeds.

Groundwater pumping is occurring from 24 pumping wells within the study area. All are privately owned and 13 are primarily used for irrigation purposes. Of these wells, 5 may have associated groundwater rights. Pump withdrawals are between 60 and 106 ac-ft per year.

4.4.2.2 Reclaimed Water

Reclaimed water is secondary effluent wastewater that receives additional treatment, leaving it clean enough to be 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. Most recipients irrigate turf or agricultural properties with it.

Reclaimed water 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. 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.

4.4.2.3 Water Quality

A water quality sampling program was initiated in 1986 by the Rillito River Recharge program to document background water quality for future use in evaluating pollution in the project area, anticipating a need to correct non-point source discharge contaminants from urban runoff and perhaps river flow itself.

Water quality samples were collected at 11 sites. Analysis of these samples revealed certain organic and inorganic contaminants drawn from some wells. Some constituents, such as nitrates, toluene, organic compounds, and sulfonamides, occur at concentrations that may be potentially harmful to public health. As a result, the wells were sampled again in June of 1987. These samples confirmed the presence of constituents of potential health concern. Table 4.4-1 summarizes the water quality data for the monitoring wells that had constituent concentrations of potential health concern.

TABLE 4.4-1
WATER QUALITY SAMPLES WITH CONSTITUENT CONCENTRATIONS OF POTENTIAL HEALTH CONCERN

Well ID	Constituents of Potential Health Concern
(D-13-14) 26BBB	Nitrates 18.0 mg/l exceeded Primary MCL of 10 mg/l expressed as nitrogen (N)
	Toluene 3.2 µg/l
(D-13-14) 26DAC3	Tentatively identified organic compounds of potential health concern
(D-13-14) 27BDB4	Sulfonamides 221 µg/l and other tentatively identified organic compounds of potential health concern.

SOURCE: Appendix C: Groundwater and Water Budget, appendix to the Rillito River, Pima County, Arizona, El Rio Antiguo Feasibility Study.

In addition, the U.S. Geological Survey (USGS) sampled wells to determine the variability of groundwater quality throughout the year. Wells south of the Rillito were found to have moderately hard to hard water (hardness as $CaCO_3$ < 120 to 130 mg/l), pH levels ranging from 6.0 to 7.4, and relatively high levels of dissolved solids (148 to 222 mg/l). Concentrations of calcium ranged between 32 and 47 mg/l; sodium between 8 and 18 mg/l; and bicarbonate between 90 and 176 mg/l in water from these wells.

4.4.2.4 Hydrology and Geomorphic Ecosystem Processes

The numerical results from the Ecosystem Functional Assessment (§4.2) cast the existing conditions of ecosystem processes in a more quantitative fashion. Regarding the

geological and hydrological influences on the Rillito, five separate measure of functional capacity are directly pertinent:

1. Flowing water shapes gross features
2. Temporary retention of water on the surface
3. Long-term storage of water on or just below the surface
4. Infiltration through the saturation zone to the water table
5. Stream flow carrying nutrients into biotic communities

Functional capacity indices reveal a river very much out of hydrological and ecological balance. Previous efforts to control overbank flooding, bank erosion, and lateral migration of the channel took the form of soil cement revetments and grade control structures in the river bottom. While these accomplish a conscious design objective, they also mean that large-scale geomorphologic changes no longer occur.

The FCI for process #1, FCI = 0.04, reflects that impairment (see Table 4.2-1). Those same water managing aspects of its design largely preclude the geomorphic creation of irregular, bumpy, or otherwise heterogeneous surface features where water would pond temporarily; note the low value indicative of the ability to retain water on the surface, even if briefly (FCI for process #2 = 0.18). The Rillito has nothing even approaching sequences of runs, riffles, and pools. Indeed, its low flow channel follows the geophysical route of maximum water speed around the outside of bends and with virtually no sinuosity.

The river bottom consists very much of coarse sands and silty sands and therefore lacks for boulder fields or other harder substrates to create diverse channel conditions. Grade control structure exacerbate this uniformity, as they constrain flows to transit the river as fast as possible without altering its capacity to retain water at or just below the surface; hence, the measure of poor capacity for process # 3, FCI = 0.14.

In the final result captured as ecosystem process #4—that is, processes 1, 2, 3, and their interactions—only a very small fraction of runoff that might otherwise permeate the channel sediments and reach even the saturation zone above the water table actually does. Runoff races through the Rillito, rather than percolating into porous alluvial sediments. The capacity for effective percolation to the water table, thence toward the deeper aquifer, is virtually nil, FCI = 0.0.

Stream flows also have a direct ecosystem process in the capacity to bring mineral and organic nutrients into biological communities from distant sources; process #6. Sporadic summer thunderstorms, which give rise to episodic flow regime, transport nutrients from mountainous geologic sources upstream only during a single season of the year. The organisms that compose biotic communities need those nutrients throughout the year and at a fairly steady rate. Absence of a steady, or at least a regular, flow influences most the

poor capacity of the river to sustain this ecological process and causes a very low FCI value, 0.08 (see Table 4.2-1).

4.4.2.5 Hydrology

The bank protection using soil cement considered the 100-year flood peak discharge that was determined for the 1988 flood insurance study (FIS) for the city of Tucson. The FIS 100-year peak discharge is 32,000 cubic feet per second (ft^3/sec) for the entire project reach. Design capacity for stabilized banks was set at either 32,000 ft^3/sec or existing top of bank, whichever was higher. So, it is reasonable to assume that peak discharge frequencies for the 100-year event, most recently estimated at 29,900 ft^3/sec for the 1915–2000 period of record, would be contained by the soil cement banks (Table 4.4-2). The floodplain is not likely to extend beyond the confines of the soil cement until the peak discharge frequency exceeds 32,000 ft^3/sec. Therefore, the estimated 100-year peak discharge frequency of 29,900 ft^3/sec would be contained within the soil cement banks. Further clarification of the hydraulic analysis is presented in Appendix A: Hydrology, an appendix to the Feasibility Study Main Report.

TABLE 4.4-2
RILLITO RIVER NEAR TUCSON, PEAK DISCHARGE-FREQUENCY VALUES, COMPARISON OF ANALYTICAL RESULTS, 1984 DM (1915–1980) VS. CURRENT EVALUATION (1915–2000)

	Peak Discharges, ft^3/sec (cubic feet per second)			
Period of Record	500-Year	100-Year	50-Year	10-Year
1915–1980	40,000	27,000 (25,500)	22,000	13,000
1915–2000	44,200	29,900	24,600	13,900

NOTES: The 1915–1980 flow record is the basis for the values presented in the 1992 Design Memorandum.

All discharges are *expected probability.*

The 100-year discharge for the 1915–1980 period in parentheses is the analytical value. The adopted value is also shown, based upon weighting with USGS regional curves.

Above information is based on the report, Rillito Creek (River), AZ, Review of Discharge-Frequency Relationships for Economic Evaluation of Alternatives, by N. N. Adelmeyer, USACE.

The Rillito River drainage area has experienced several 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 ft^3/sec. Table 4.4-3 lists the major storms and floods of record along with peak discharge stream flows.

TABLE 4.4-3
PEAK DISCHARGE FLOWS FOR STORMS AND FLOODS OF RECORD

Date	Description	Peak Discharge
December 23, 1914	Storm and flood event with a nearly continuous 8-day rainfall. Series of storms associated with Pacific Ocean and El Niño conditions. Because of saturated ground and more intense rainfall, water ran high in many streams. Most of the flow appears to have been contributed by Tanque Verde Creek. Precipitation in the area ranched from approximately four to eight inches.	17,000 ft^3/sec on the Rillito River (USGS Gauge No. 0948600)
July 31, 1921	Frequent storms throughout the month saturated the ground, leading to runoff in streams. The Santa Catalina Mountains received the bulk of rain during the latter part of the month. Origin of flow is thought to be primarily from Pantano Wash. Despite the flooding, the available precipitation measurements in the area were relatively low, ranging from less than one inch to almost three inches.	16,000 ft^3/sec on the Rillito River near Tucson.
September 23, 1929	Storms and floods with scattering of heavy thunderstorms, possibly associated with tropical storm events in the Pacific. Most flow appears to have been contributed by Pantano Wash. Precipitation measurements in the area ranged from around two to three and half inches.	24,000 ft^3/sec on the Rillito River.
December 18, 1978	Widespread moderate to heavy precipitation in the Rillito River drainage area, along with some local heavy thundershowers, resulted in precipitation measurements of eight and a half inches in the Santa Catalina Mountains. Heavy flows in Tanque Verde Creek and moderate flows in Pantano Wash contributed to the discharge on the Rillito River.	● 16,400 ft^3/sec on Rillito Creek near Tucson. ● 12,700 ft^3/sec on Tanque Verde Creek (USGS Gauge No. 09484500) ● 1,530 ft^3/sec on Pantano Wash (USGS No. 09485500)
October 3, 1983	Abnormally heavy precipitation following an unusually wet winter lead to the flood event. Heavy showers and major thunderstorms resulted in precipitation measurements of around 7 inches to unofficial estimates of 15 inches in the mountains. This resulted in all-time record flows on the San Francisco and Upper Gila Rivers, as well as the Rillito River.	29,700 ft^3/sec on Rillito River near Tucson (USGS Gauge No. 09486000)

SOURCE: Appendix C, Groundwater and Water Budget Report, appendix to Rillito River, Pima County, Arizona, El Rio Antiguo Feasibility Study, 2004.

4.4.2.6 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.

In the El Rio Antiguo study area, the banks of the Rillito River have been stabilized with soil cement protection. Grade control structures have also been constructed, mostly by the bridges, to help stabilize the channel bed, prevent migration upstream of gradient changes (i.e., halt "head-cutting"), and protect the toe of soil cement banks from scour. 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. Details can be found in Appendixes A and B: Hydrology and Hydraulics, appendixes to the Feasibility Study Main Report.

4.4.2.7 Floodplain

Hydraulic modeling was done for the Rillito River using the USACE's HEC-RAS, River Analysis System Program (HEC-RAS). The model was prepared for the Rillito River reach from Craycroft Road to First Avenue, which includes the reach within the El Rio Antiguo study area. Details of the hydraulic modeling process are discussed in Appendix B: Hydraulics, appendix to the Feasibility Study Main Report.

Preliminary hydraulic modeling efforts used discharges for flood events that have since been reevaluated (24,000 ft^3/sec for 50-year, 32,000 ft^3/sec for 100-year, and 64,000 ft^3/sec for 500-year). This information used in the preliminary hydraulic modeling is based on estimated frequency discharges from the Corps document, *Design Memorandum, Rillito River, Tucson, Arizona, Bank Protection, October 1992*, using the 1915 to 1980 period of record, by the Corps Los Angeles District in 1992. During the course of the feasibility study, the discharge-frequency rates for the Rillito were reevaluated using the 1915-2000 available record (vs. the 1915-1980 available record for the previous reports). With the extension of the available record, the current hydraulic evaluation indicates that the peak discharge-frequency is greater than was originally computed. Table 4.4-2, Rillito River near Tucson, Peak Discharge-Frequency Values,

lists the peak discharge-frequency rates for the 1992 Corps Design Memorandum and for the current evaluation based on extension of the available record[1].

4.4.3 References

Pima County Department of Transportation and Flood Control District

1992 Design Memorandum, Rillito River, Tucson, Arizona, Bank Protection, LAD, October. USACE Los Angeles 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.

2002 Rillito Creek (River), AZ, Review of Discharge-Frequency Relationships for Economic Evaluation of Alternatives. USACE Los Angeles District. June.

[1] Additional information regarding Rillito River discharge-frequency is based on a report, Rillito Creek (River), AZ, Review of Discharge-Frequency Relationships for Economic Evaluation of Alternatives by Nick N. Adelmeyer, USACE.

4.5 Biological Resources

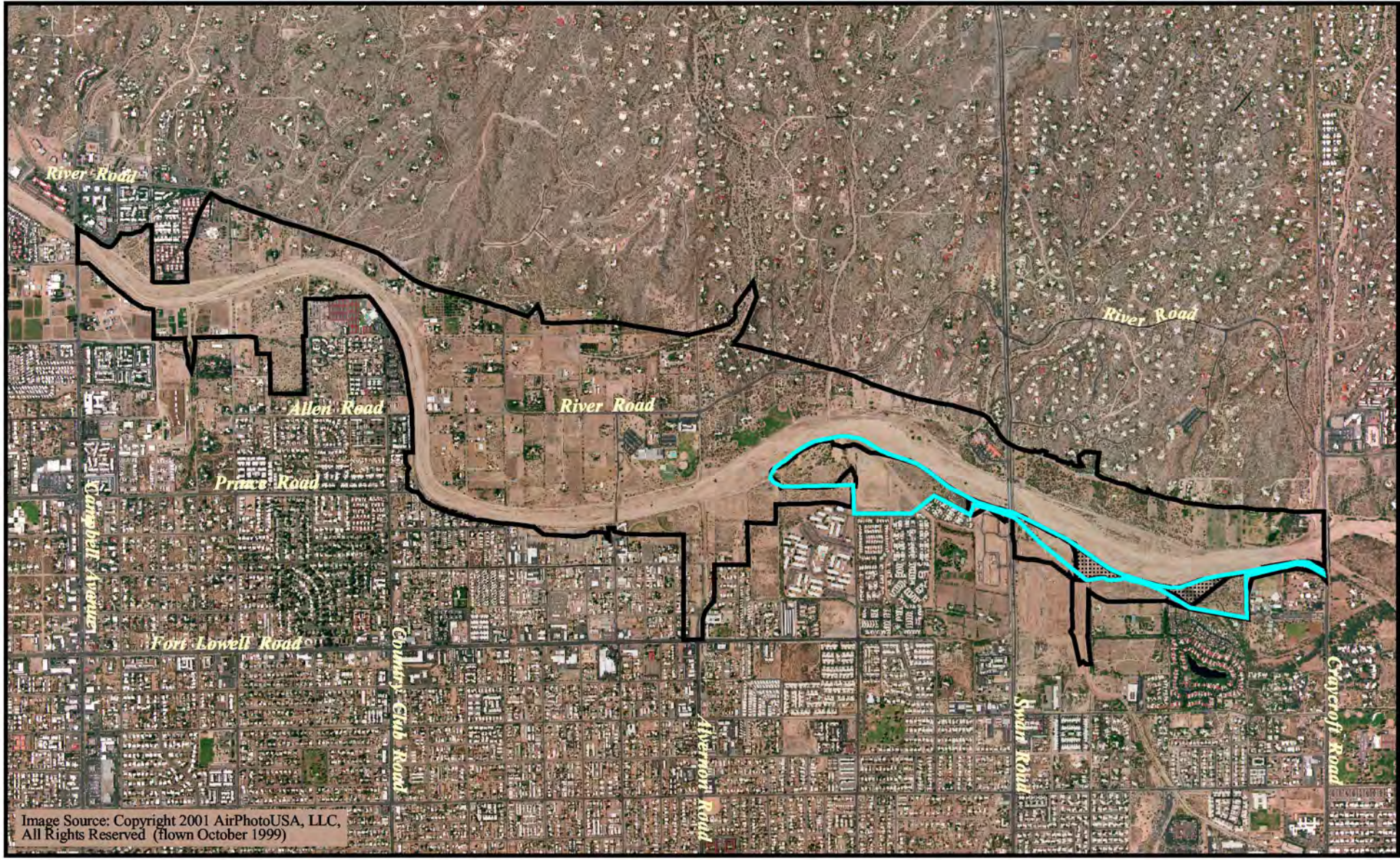
4.5.1 Introduction

A functional ecosystem composed of diverse riparian communities flourished here a century ago, but withered and vanished in the decades when Tucson grew. The unintended degradation of the Rillito's riparian qualities, but one example among a great many in the arid southwest, is now understood as having affected in a regional way important habitat for a wide variety of plants and animals. Stream courses through otherwise upland habitats that are typically quite dry and devoid of rich vegetation amounted to strings of habitat vital to the life cycles of migratory and year-round resident bird species which depended upon riparian areas for foraging and breeding areas, the different habitat needs of small mammals, lizards, snakes, and invertebrates, which in turn are preyed upon by larger mammals, birds, and bats. Riparian corridors allow wildlife to travel between areas. These strings of habitat, while encompassing less than one percent of the Southwest landscape, support a disproportionately high number of wildlife species. Degradation or loss of riparian habitat within Pima County has had great impacts on most resident species. It is estimated that 85 to 95 percent of quality riparian habitat in Pima County has been lost over the past century. Partial restoration of those more prominent biotic communities and the ecosystem they create is the goal of this study.

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 4.5-1).

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 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



El Rio Antiguo study area

Not included in El Rio Antiguo study area

Swan Wetlands, UCACE 1135 project
(Source: USACE, 2001)

N 0 Miles 0.45

FIGURE 4.5-1

Aerial Photograph of the El Rio Antiguo Study Area and Rillito/Swan Wetlands

M:\jobs2\3640\env\gis\F4_ch4-nov03.apr\Fig4.5-1 (swan wet) 11/17/03

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).

4.5.2 Contiguous Restoration Projects

An area on the south bank of the Rillito River, within the El Rio Antiguo study area, is the subject of an Aquatic Ecosystem Restoration Project proposed for authorization under Section 1135 of the Water Resources Development Act. This project is known officially as the Rillito River 1135 Ecosystem Restoration Project. Congressional appropriations mediated through the Water Resources Development Act authorized the USACE to engage with local cost-sharing sponsors in comparatively small habitat restoration projects. Pima County Transportation and Flood Control District solicited this work as the formal local sponsor.

The 1135 project site, approximately 64 acres, occupies degraded lands centered at the northern end of Columbus Road (see Figure 4.5-1). The eastern part is 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 almost to Craycroft Road.

The existence of this Section 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 River 1135 project area would be disregarded for this current analysis. Existing biotic conditions would not be described, nor would they be tallied. In effect, this portion of the Rillito's south bank would simply be ignored altogether.

4.5.3 Environmental Setting

4.5.3.1 Functional Ecosystem in Regional and Historical Context

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 100 years. Prior to those gradual alterations, the Rillito River flowed perennially, fed by runoff from the mountains to the north, east, and south. Unseen, water also moved below the surface all year long. Equilibrium between surface water and the water table kept its riparian ecosystem comparably dynamic. A verdant, healthy, and self-perpetuating cottonwood

gallery would have been the most conspicuous feature along the banks of that riparian community. Ash, walnut, hackberry, and other tree species able to achieve notable stature would have mixed with the outer cottonwoods and been more dominant slightly farther from the water. At a greater distance back from the banks, those taller trees would have given way to mesquite, paloverde, and other species that prefer drier surfaces but which still must be able to tap a reliable water source below ground.

Moving inward toward perennial water, large shrubby perennials growing beneath the cottonwoods created a distinct understory, where intertwined branches entangled organic debris and sediments carried downstream by larger discharges. Cienegas formed at places inside of the banks where the stream bottom happened to be more porous. Large snags hung up on sandbars helped create microhabitat along the stream and barriers that caused depositional patterns of sediments to shift periodically. Newly formed sandbars became sites where seedlings of all sorts could take root and, if they became established, could partially stabilize the new ground. Nutrients carried downstream would cycle within the various components of that riparian community, being taken up first by annual and perennial plants, next by herbivorous animal species which resided there or passed through during seasonal migrations, next reaching carnivores as they ate prey, and finally returning to the soils as fungi and bacteria decomposed the physical remains of dead plants and animals. Ultimately, nutrients moved steadily downstream, although the organisms living at any one spot could borrow temporarily from this stream.

Water moving through it was fundamental to defining and sustaining this ecosystem. The numerous, varied species to be found there 125 years ago would each have been inextricably linked to flow regimes in the shifting streambed, the appearance of new bare areas as sediments piled up where currents slowed, and the erosive loss of trees and soils from other areas and would have mutually influenced each other's life history through a great many ecological processes and attributes, each process in dynamic equilibrium and each constrained and modified by all the others.

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 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.

4.5.3.2 Quantifying Ecological Processes and Biological Resources

The numerical calculations that emerged from the Ecosystem Functional Assessment procedure (§4.2) indicate the poor capacity for essential ecosystem processes along the Rillito, when judged against current conditions at references sites. These ecological processes divide conveniently into two general categories:

Nutrient transport and cycling processes

5. Cyclical movement of nutrients within organisms
6. Stream flow carrying nutrients into biotic communities (also influenced by hydrological and geomorphic circumstances)
7. Physical retention of particulate materials

Species interaction processes

8. Species diversity
9. Spatial organization of biotic communities
10. Habitat continuity and importance to movement of animal species
11. Separation from adjacent urban influences

An ecological characterization of existing conditions, which manifest themselves as functional capacity indices calculated by the EFA, follows below. Average annualized functional capacity units (also presented in §4.2) are included, but the actual acreages from which those results come (FCU = FCI × area, in essence ecosystem quality multiplied by area) follow below in the verbal and tabular description of exiting biological resources. The AAFCU values will seem rather tenuous. They are offered here for comparative purposes in the evaluation of impacts, to follow in Chapter 5, where percentage change in AAFCU will convey more information.

Ecological process #5. In a nutshell, this process encapsulates the food webs and broad niches organisms occupy in ecosystems. Plants draw mineral nutrients from the soil, photosynthesize and incorporate those nutrients along with organic compounds into plant tissue; herbivores eat plants and grow in size by virtue of the nutrients they ingest, reproduce by virtue of the same nutrient economy; predators eat herbivores (and the nutrients they contain), and so on and so on. Decomposition of dead organisms releases nutrients back to the soil where plants may take them up again; and so on and so on. Very impoverished biotic assemblages (plants and animals) mean nutrients cannot cycle through organisms that are not there. The FCI for this process gave a result of 0.014. The corresponding measure for AAFCU = 31.4 indicates minimal extant acreage of biotic communities remains in and along the Rillito (see Table 4.2-1).

Ecological process #6, from an organismal perspective, rather than hydrological. Sporadic summer thunderstorms, which give rise to episodic flow regime, transport nutrients from mountainous geologic sources upstream only during a single season of the year. The organisms that compose biotic communities need those nutrients throughout the year and a fairly steady rate. Absence of a steady, or at least a regular, flow influences most the poor capacity of the river to sustain this ecological process and cause a very low FCI value, 0.08 (see Table 4.2-1). AAFCU = 18.1 would indicate that

although biotic communities are sparse, their inhabitants can avail themselves of nutrients when the opportunity arises.

Ecological process #7. Absence of effective surface irregularities causes both fast movement of water, and therefore a flushing action, rapidly smoothing out natural features where organic detritus might otherwise accumulate. A few scattered trees (black willow [*Salix gooddingii*] and cottonwood (*Populus fremontii*]) that have managed to grow to modest size in the river bottom do cause deposition of waterborne materials downstream of them. Surface irregularities and some woody debris at a few places on the overbanks also catch and retain some particulate materials. FCI= 0.15; AAFCU = 35.3

Ecological process #8. The layers of foliage and vertical stratification common to riparian ecosystems does not now exist most places along the Rillito and, in consequence, the expected habitat niches are absent, by and large. Fewer plant species are present than otherwise would be, and their absence in turn prevents assorted animals species from finding suitable habitat. The general poverty of species also results in predominance by a few shrubby plant species, one of them an aggressive alien, in the total mix. Consequently, FCI is rather low, FCI = 0.15, but enough plant cover exists to draw in some animal species and cause AAFCU to equal 32.33.

Ecological process #9. Periodic floodwaters remove most of the plants from the river bottom before they have a chance to grow large enough to withstand those flows. Except in isolated spots in the river, flow regimes constrain plant assemblages to single layer; reflected by FCI = 0.18. Small thickets of mesquite on overbank areas do add somewhat to structural complexity in the project area, but they are of very limited surface area and hence AAFCU for existing conditions indicates poor ecological process in general; AAFCU = 40.4.

Ecological process #10. Flow regimes also stifle the expansion of plant communities along the riverbed. Nowhere within the channel do any contiguous assemblages exist now. A single stand of mesquite on the right overbank upstream of Swan Road has been spared from removal. Otherwise, most large plants grow as isolates or clusters of minimal size. On the other hand, animals can move rather freely, primarily because the riverbed is unobstructed and a convenient pathway lines the top of most of the banks, albeit the pathway was made for people. The Rillito still affords an efficient migratory corridor from better quality habitat upstream all the way to the Santa Cruz River. The existing quality is passable, FCI = 0.32, and the area involved gives an AAFCU = 74.6.

Ecological process #11. In actuality, this process encompasses economic and land use decisions more than a real ecological mechanism at work. Its value rests in the degree to which buffer conditions exists between biotic communities and the human urban development. It is buffer between nature and city. Vacant land and open space are the

two most widespread features that act as buffer region close to the Rillito. Of all the processes fashioned into the EFA, this has the highest value for existing conditions; FCI = 0.58 and AAFCU = 202.9.

4.5.3.3 Existing Conditions

a. Soils

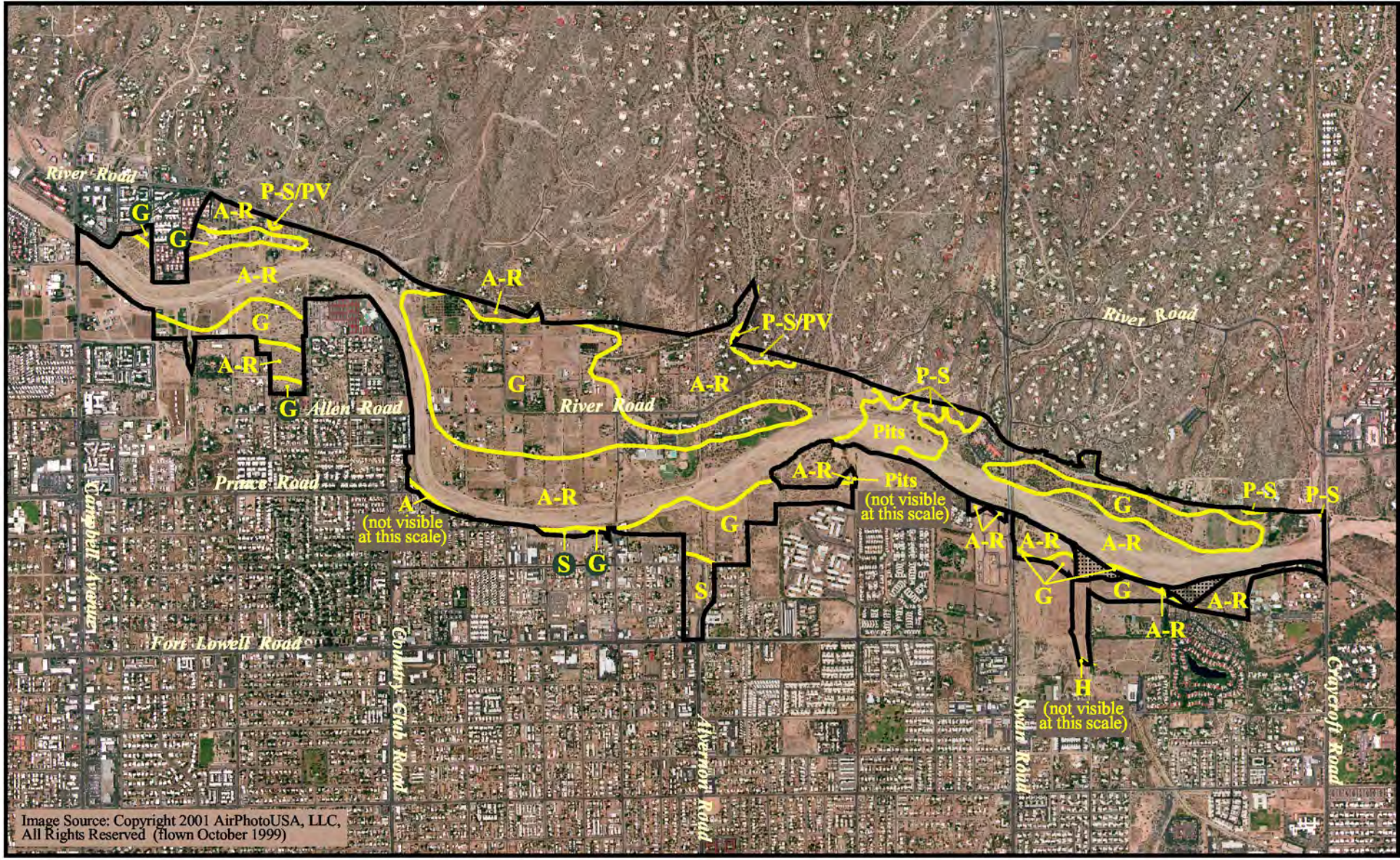
Seven soil series and classifications are present within the El Rio Antiguo study area and are depicted in Figure 4.5-2. Arizo-Riverwash Complex 0-3 percent slopes and Glendale silt loam 0-3 percent slopes compose approximately 90 percent of the project area including nearly all of the river floodplain 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 communities for this section of the existing conditions were mapped and delineated in accordance with 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 were typically classified as Sonoran deciduous swamp and riparian scrubland on a broad scale. In contrast to the broad-scale approach of the Brown, Lowe, and Pase (1994) classification system used for vegetation mapping in this section of existing conditions, which tends to focus on the dominant vegetation type, cover type delineation focuses on distinguishing areas with similar physical, chemical, and biological characteristics. For example, portions of an area mapped as Sonoran riparian scrubland under the Brown, Lowe, and Pase (1994) classification system, may be considered cottonwood willow forest, while other areas may be considered scrub/shrub habitat. Cover type mapping was



El Rio Antiguo study area

Not included in El Rio Antiguo study area

N

0 Miles 0.45

Soils (Source: USDA-NRCS 1999)

- A — Anthony fine sandy loam, 0 to 3 percent slopes
- A-R — Arizo-riverwash complex, 0 to 3 percent slopes
- G — Glendale silt loam, 0 to 3 percent slopes
- H — Hantz loam, 0 to 1 percent slopes
- P-S — Pinaleno-stagecoach complex, 5 to 16 percent slopes
- P-S/PV — Pinaleno-stagecoach-palos verdes complex, 10 to 35 percent slopes
- S — Sahuarita soils, mohave soils and urban land, 1 to 5 percent slopes
- Pits — Pits, dumps

FIGURE 4.5-2

Soils within the El Rio Antiguo Study Area

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important to the functional assessment in that it focused on areas of similar ecological processes.

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 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.

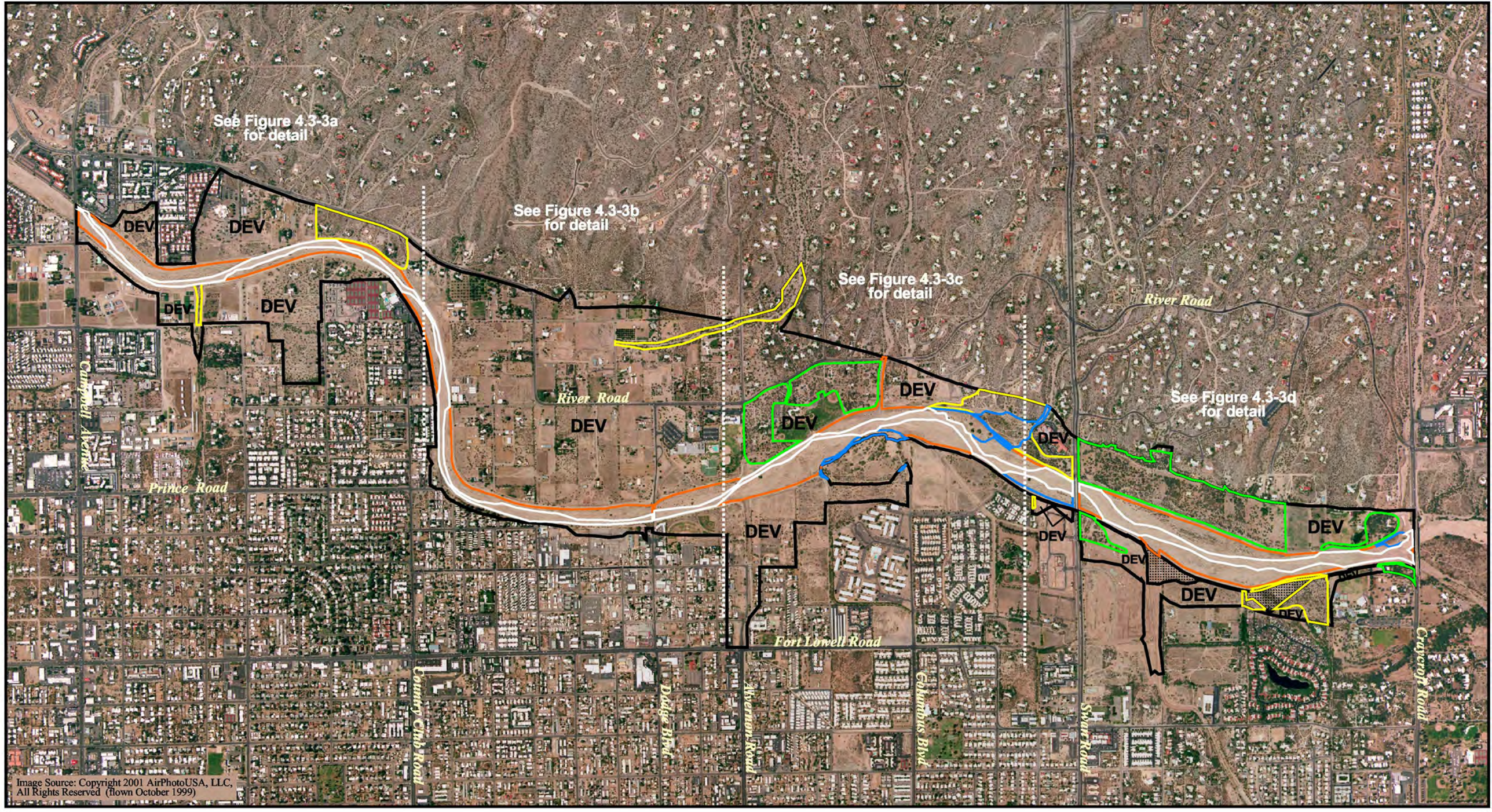
Riparian-dependent plant communities, such as riparian scrub, strand, and mesquite bosques, are considered sensitive vegetation communities in the Southwest, including Pima County. These riparian communities have been adversely impacted by diversion of and reduction in stream flow, the depletion of groundwater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

Vegetation communities are described below, summarized in Table 4.5-1, and depicted in Figure 4.5-3. 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 4.5-2.

TABLE 4.5-1
VEGETATION COMMUNITIES

Vegetation Community	Acres
Sonoran Desert Scrub, Paloverde–Mixed Cacti Series (154.12)	50.0
Sonoran Riparian and Oasis Forests, Mesquite Series (224.52)	96.9
Sonoran Deciduous Swamp and Riparian Scrub, Mixed Scrub Series (234.71)	19.6
Sonoran Interior Strand, Mixed Scrub Series (254.71)	118.0
Current Low Flow Channel (999.41)	62.9
Developed (999.21)	718.6
TOTAL ACREAGE	1,066.0

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



El Rio Antiguo study area

Not included in El Rio Antiguo study area

Matchline

N 0 Feet 1500

Vegetation Communities (BLP Code) (Source: RECON, 2002)

- 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

DEV Developed

FIGURE 4.5-3

Vegetation Communities, Overview

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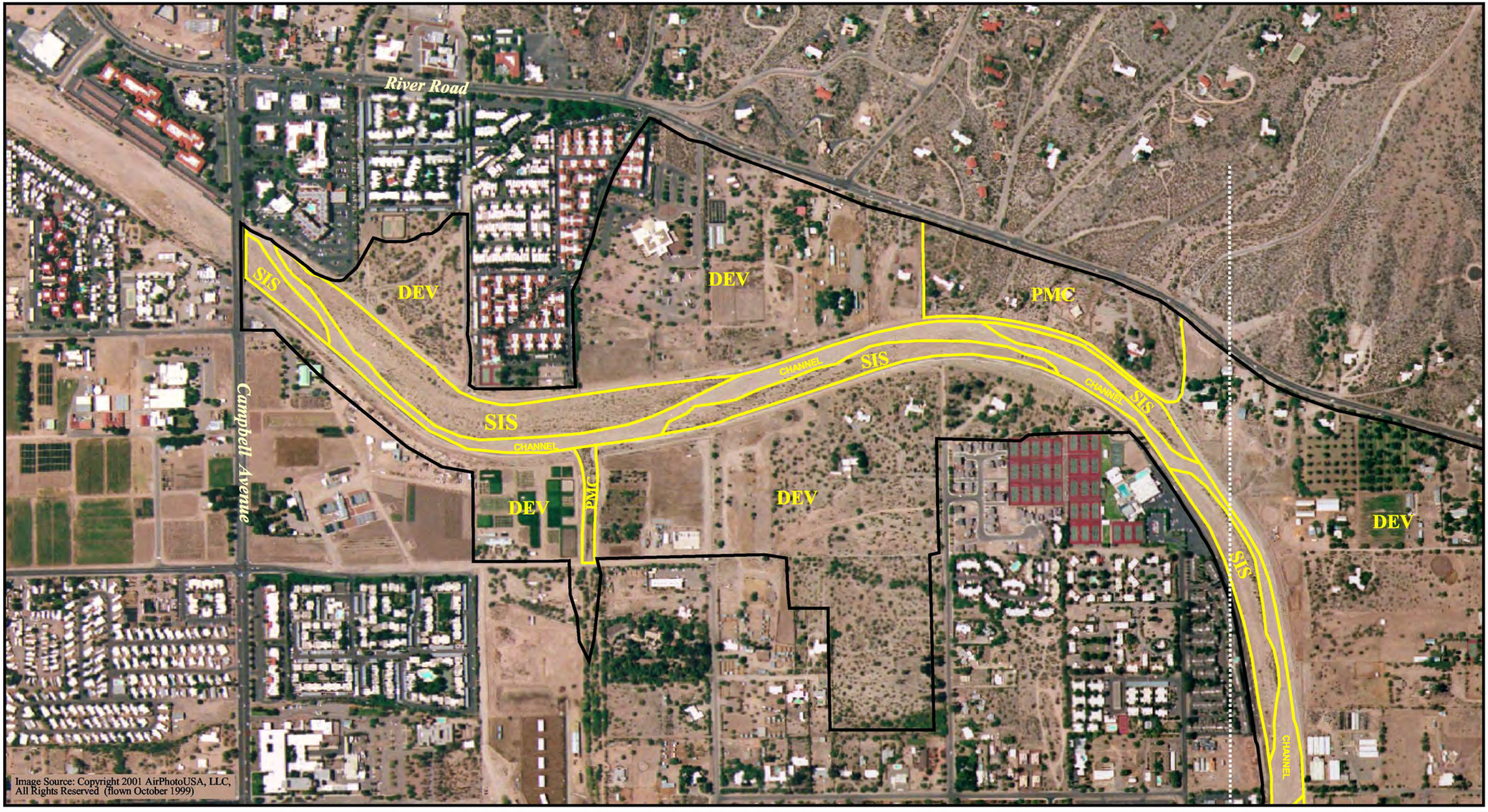

El Rio Antiguo study area

Matchline

Vegetation Communities (BLP Code) (Source: RECON, 2002)

PMC	Paloverde-mixed cacti (154.12)	CHANNEL	Current Low Flow Channel
SIS	Sonoran interior strand (254.70)	DEV	Developed

N 0 Feet 525

FIGURE 4.5-3a

Vegetation Communities

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El Rio Antiguo study area

Matchline

Vegetation Communities (BLP Code) (Source: RECON, 2002)

PMC	Paloverde-mixed cacti (154.12)	CHANNEL	Current Low Flow Channel
SIS	Sonoran interior strand (254.70)	DEV	Developed

N 0 Feet 525

FIGURE 4.5-3b

Vegetation Communities

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Image Source: Copyright 2001 AirPhotoUSA, LLC, All Rights Reserved (flown October 1999)

El Rio Antiguo study area

Matchline

N 0 Feet 525

Vegetation Communities (BLP Code) (Source: RECON, 2002)

- PMC — Paloverde-mixed cacti (154.12)
- M — Mesquite (224.52)
- SDS/RS — Sonoran deciduous swamp and riparian scrub (234.70)
- SIS — Sonoran interior strand (254.70)
- CHANNEL — Current Low Flow Channel
- DEV — Developed

FIGURE 4.5-3c

Vegetation Communities

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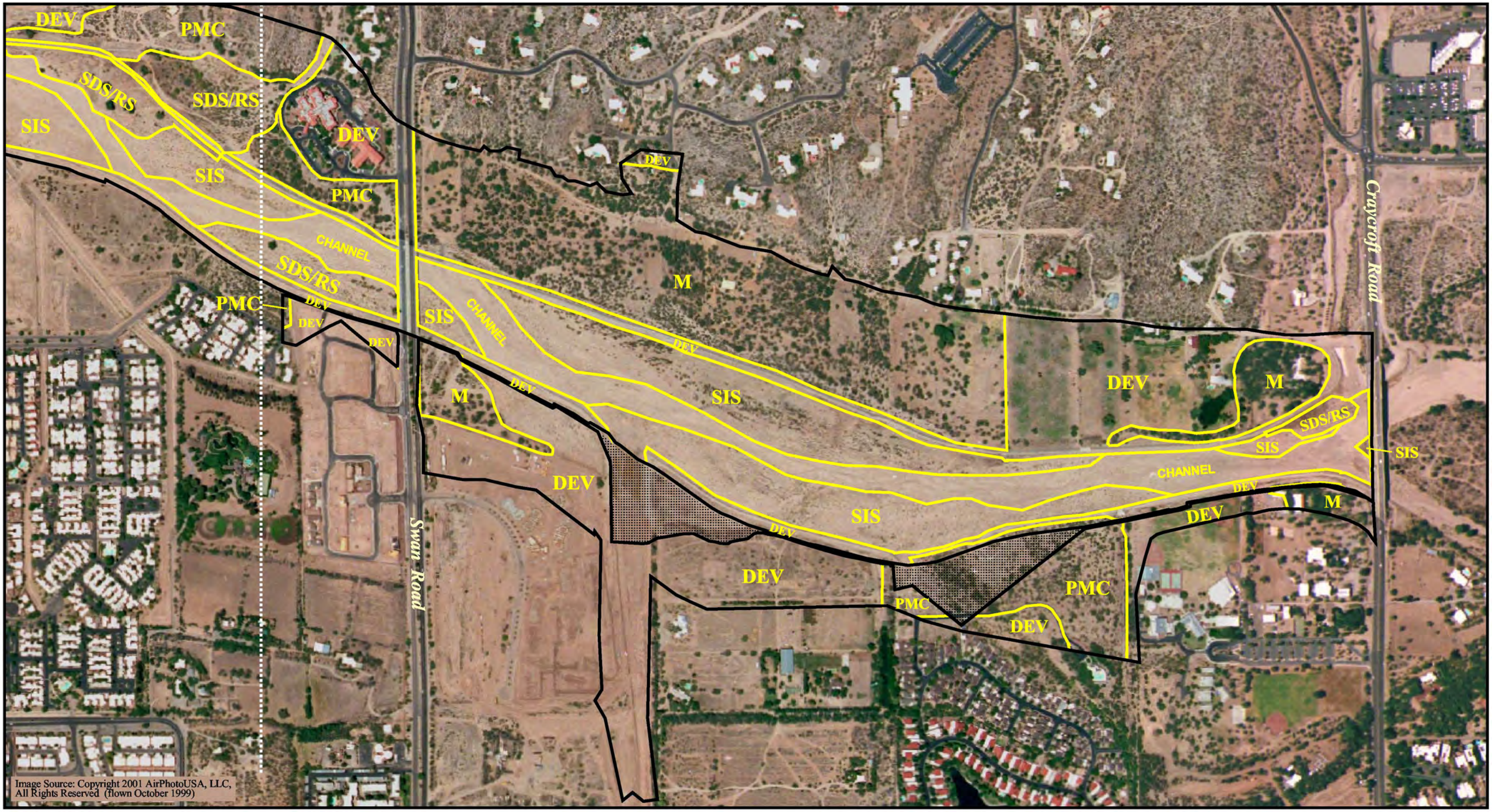

El Rio Antiguo study area

Not included in El Rio Antiguo study area

Matchline

N 0 Feet 525

Vegetation Communities (BLP Code) (Source: RECON, 2002)

- PMC Paloverde-mixed cacti (154.12)
- M Mesquite (224.52)
- SDS/RS Sonoran deciduous swamp and riparian scrub (234.70)
- SIS Sonoran interior strand (254.70)
- CHANNEL Current Low Flow Channel
- DEV Developed

FIGURE 4.5-3d

Vegetation Communities

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TABLE 4.5-2
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 4.5-2
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

154.12-Sonoran Desert Scrub, Paloverde-Mixed Cacti Series (50.0 acres). This habitat association is a major component of the Arizona Upland Subdivision as defined 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.

224.52-Sonoran Riparian Deciduous Forest, Mesquite Series (96.9 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.).

Almost 97 acres of mesquite bosque are present along the terrace of the Rillito River, all of which have been disturbed by grazing and/or urbanization. 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 (19.6 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 4.5-1.

254.71-Sonoran Interior Strand, Mixed Scrub Series (118.0 acres). Sonoran interior strand, or the vegetation within stream channels, typically supports 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.

In the study area, most of the vegetation in the Rillito River channel 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 4.5-2. 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 (62.9 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 (720.8 acres). The developed areas within the El Rio Antiguo study area consist of baseball fields, urban parks, roads and residential, and commercial buildings.

PHOTOGRAPH 4.5-1

Sonoran deciduous swamp and riparian scrubland community west of Swan Road

Note the cottonwood trees in this scrub community

PHOTOGRAPH 4.5-2

Representative Sonoran interior strand community within the Rillito River

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 4.5-3.

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*).

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 4.5-3
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
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

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 would also forage in adjacent communities.

A side-blotched lizard (*Uta stansburiana*) was detected on-site. There is a chance that species common to the region, such as tree lizards (*Urosaurus ornatus*) and the gopher snake (*Pituophis melanoleucus*), may also occur on-site (Stebbins 1985).

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 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.).

4.5.3.4 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 Sonoran Desert Conservation Plan (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 4.5-4 and corresponding sensitivity codes are defined in Table 4.5-5. 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.

TABLE 4.5-4
SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA

Species	Status	Habitat	Occurrence/Comments
PLANTS			
Catclaw acacia *Acacia greggii*	PNP	Slopes, canyons, desert washes, streams, and grasslands below 5,000 feet.	Potential to occur in the mesquite communities.
Desert hackberry† *Celtis pallida*	PNP	Washes, canyons, and open desert between 1,500 and 3,500 feet.	Observed in the study area.
Netleaf hackberry *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† *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 *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 (Hickman 1983). Not expected to occur due to disturbed nature of upland habitat.
Arizona fishhook barrel cactus† *Ferocactus wislinzenii*	PNP	Sandy, gravelly soils in desert grasslands; 1,000 to 4,500 feet.	Observed in the desert scrub community.
Huachuca water umbel *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† *Prosopis velutina*	PNP	Desert washes and streams; high groundwater; below 5,000 feet.	Observed in the mesquite and Paloverde-cacti communities.
Tumamoc globeberry *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 4.5-4
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 *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 *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 *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 *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 *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 *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 *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 in the SDCP (Pima County 2002).
REPTILES (Nomenclature from Collins 1997)			
Desert box turtle *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 (Pima County 2002). Currently, not expected to occur due to lack of suitable habitat.

TABLE 4.5-4
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 *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 (Pima County 2002).
Mexican garter snake *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 (HDMS 2001). Currently not expected to occur due to limited riparian vegetation and lack of permanent water.
Tucson shovel-nosed snake *Chionactis occipitalis klauberi*	SDCP	Mixed riparian scrub, Sonoran desert scrub, mesquite bosques; sandy lose soil.	Not known to occur in the study area (HDMS 2001). Low potential to occur due to disturbed nature of site.
Ground snake *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 *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 (Pima County 2002).
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	F*, SDCP, USFS, WC	Cottonwood-willow forests near running water. Mesquite bosques during monsoon season.	Historic record south of study area (HDMS 2001). SDCP identifies high quality habitat located in the river bend area and in some upland habitat (Pima County 2002). Currently, no mature riparian forests occur in the study area. Potential habitat remains east of the study area.
Cactus ferruginous pygmy-owl *Glaucidium brasilianum cactorum*	FE, SDCP, WC	Wide variety of vegetation types. Generally desert scrub communities.	Historically known to occur in the vicinity (HDMS 2001). Study area is identified as having moderate to high habitat potential for this species.

TABLE 4.5-4
SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA
(continued)

Species	Status	Habitat	Occurrence/Comments
Western burrowing owl *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.
Southwestern willow flycatcher *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 (Pima County 2002). Currently, the riparian vegetation is too patchy and sparse to support this species.
Bell's vireo *Vireo bellii*	SDCP	Low shrubby vegetation in riparian areas, dense shrubland or woodland along lowland stream courses.	Not known from the study area (HDMS 2001); 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 (Pima County 2002). Currently, the lack of mature riparian vegetation and disturbed nature of the site likely precludes this species.
Rufous-winged sparrow *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 (HDMS 2001). Urbanization along the Rillito River likely precludes this species from occurring in the study area.
Abert's towhee† *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 (Pima County 2002). Degraded riparian habitat offers only low potential habitat.

TABLE 4.5-4
SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA
(continued)

Species	Status	Habitat	Occurrence/Comments
MAMMALS			
Western red bat *Lasiurus blossevilli*	USFS, WC, SDCP	Broadleaf riparian deciduous forests and woodlands.	No present or historic occurrences recorded near the study area (HDMS 2001). Low potential to occur in the study area due to the limited availability of suitable roosting and foraging.
Western yellow bat *Lasiurus xanthinu*	WC, SDCP	Fan palm trees and broadleaf riparian deciduous forests and woodlands.	Historical records occur from the vicinity of the study area (HDMS 2001). Due to the limited availability of trees and roosting habitat, there is a low potential for this species to occur.
Lesser long-nosed bat *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 (Pima County 2002).
California leaf-nosed bat *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 (Pima County 2002). No roosting habitat is available on-site. Not expected to occur.
Pale Townsend's big-eared bat *Plecotus townsendii pallescens*	FSC, WC, SDCP	Variety of habitats.	SDCP identifies low to moderate potential habitat in the study area (Pima County 2002). Historical records occur in the vicinity (HDMS 2001). Currently, there is a low potential for this species to forage on-site.
Arizona shrew *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 (Pima County 2002).

TABLE 4.5-4
SENSITIVE PLANT AND WILDLIFE SPECIES KNOWN (†) OR WITH POTENTIAL TO OCCUR IN THE EL RIO ANTIGUO STUDY AREA
(continued)

Species	Status	Habitat	Occurrence/Comments
Merriam's mouse *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 (Pima County 2002).

NOTE: See Table 4.5-5 for sensitivity codes.

TABLE 4.5-5
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

F* = Petitioned for listing as endangered. Federal determination is that the petitioned action is warranted but precluded by higher-priority listing actions.

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.

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.

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 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.

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 (HDMS 2001); however, the majority of habitat for these species has been developed. The historic occurrence records for these species are shown in Figure 4.5-4.

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 (Pima County 2000b). These species are addressed in Table 4.5-4 and discussed further in Attachment D.

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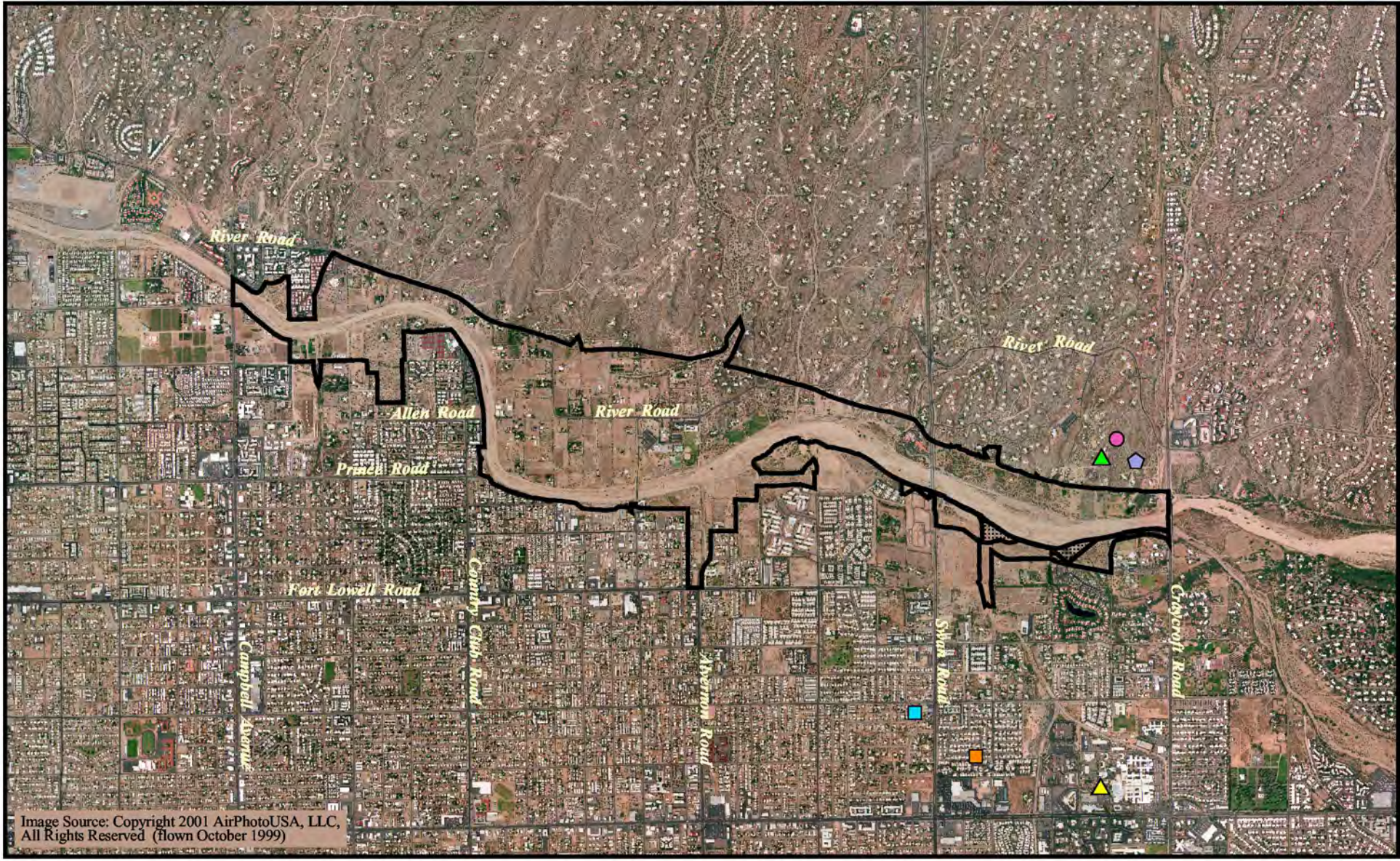

El Rio Antiguo study area

Not included in El Rio Antiguo study area

N

0 Miles 0.6

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 4.5-4

Historical Occurrences of Sensitive Species Adjacent to the El Rio Antiguo Study Area

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4.6 Land Use

4.6.1 Introduction

This section presents a characterization of existing land uses in the vicinity of the El Rio Antiguo study area. 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.

4.6.2 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. The study area lies between these mountains and the urbanized city of Tucson.

4.6.2.1 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.

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. 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 also saw an increase in residential development, as well as some industrial and commercial 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 southwest 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.

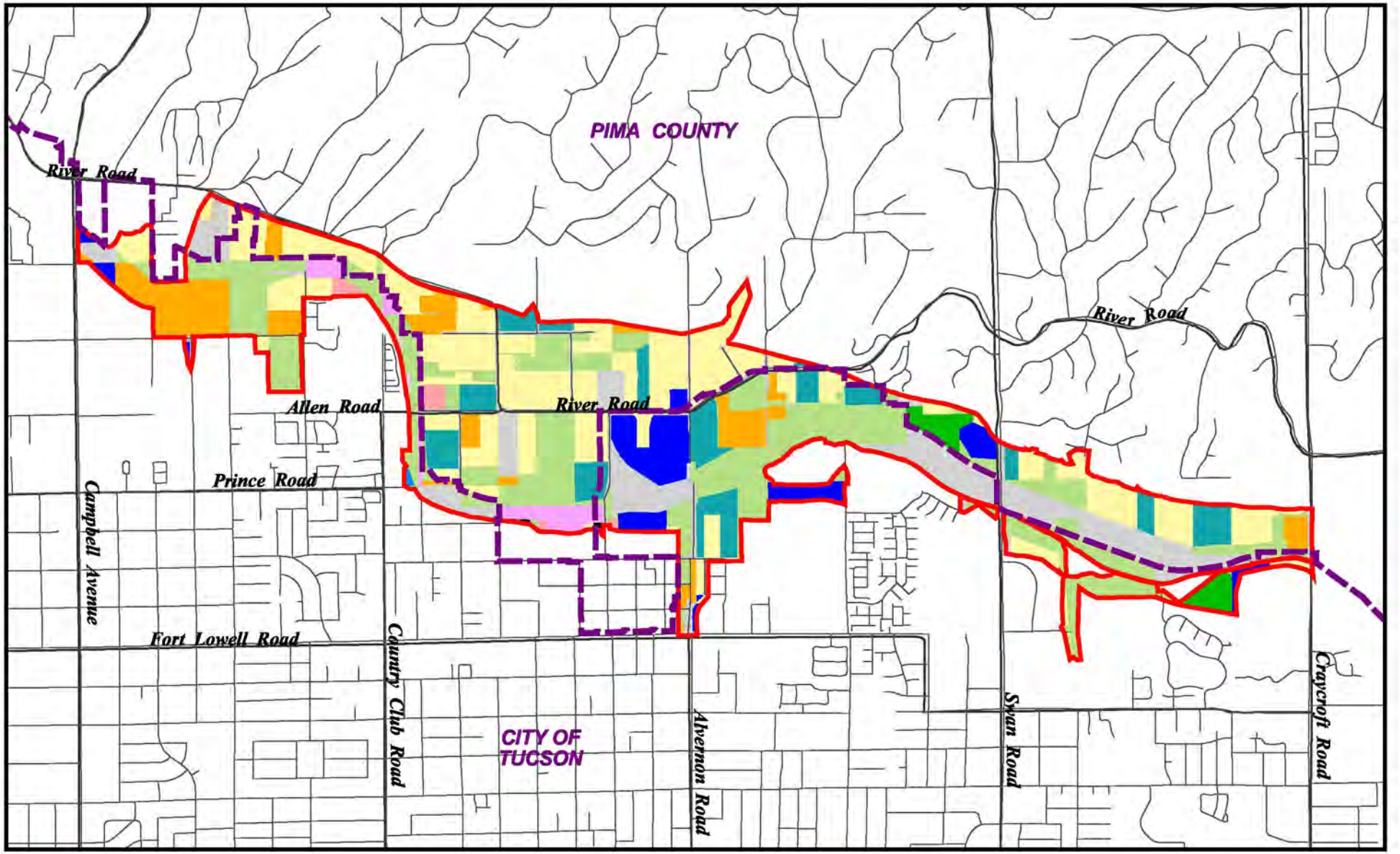
4.6.2.2 Existing Land Use

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 4.6-1 shows the land use in the El Rio Antiguo study area. Table 4.6-1 lists the corresponding acres of land use category in the study area. Below is a brief description of the land use categories and the specific uses as they are in the study area:

- Residential – single-family and multi-family housing, townhouses, and condos
- Agricultural – areas including citrus, fields, and crops
- Commercial – retail businesses and shops
- Industrial – areas of heavy equipment use, very little in the study area
- Institutional – churches and schools
- Lodging – hotels and motels
- Governmental – government-owned land and offices including parks
- Office – office space and corporate centers, very little in the study area
- Rural – land with little development and no agricultural operations
- Utilities – electric substation area and powerline easement areas
- Vacant – includes private, city, county, and school property–owned areas
- Dedicated Open Space – officially designated park areas set aside for open space
- Other – some roads and other areas that do not fall into the above categories

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 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



El Rio Antiguo study area

Land Use Categories
(Source: Pima County, DOT, 2001)

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

Jurisdictional boundary

N

0 Miles 0.45

FIGURE 4.6-1
Land Use Designations

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TABLE 4.6-1
LAND USE DESIGNATIONS IN THE
EL RIO ANTIGUO STUDY AREA

Land Use	Acres
Residential	292.1
Agricultural	6.9
Commercial	9.4
Industrial	0.9
Institutional	60.5
Lodging	0.1
Governmental	87.2
Office	0.9
Rural	88.7
Utilities	22.9
Vacant	291.9
Dedicated Open Space	20.2
Other	184.3
TOTAL	1,066.0

commercial land uses. Development of shopping plazas and apartments has occurred south of the Rillito, near Swan Road.

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 4.8, 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.

4.6.3 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. The jurisdictional boundary between Pima County and the City of Tucson is shown in Figure 4.6-1.

4.6.3.1 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 general purpose of the comprehensive plan is 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 (Pima County 2001).

The 2001 updated Pima County Comprehensive Plan (PCCP) contains the Conservation Lands System which is intended to reflect land use concepts, policies, and principles of conservation identified in the draft Preliminary Sonoran Desert Conservation Plan.

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).

4.6.3.2 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 (Pima County 2001).

4.6.3.3 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, abundant urban green space and recreation areas, and protection of the natural desert environment.

4.6.4 References

Pima County

2000 History of Land Use in Pima County: A Discussion Paper on Population Growth and Land Use Planning. Sonoran Desert Conservation Plan. January.

2001 Pima County Comprehensive Plan Update. December.

Tucson, City of

2001 City of Tucson General Plan. Plan for Tucson's Future: Improving Our Strategy for a Livable Community. August.

City of Tucson General Plan website
http://www.ci.tucson.az.us/planning/grosmart/newgp.htm

Pima County Comprehensive Plan website
http://www.dsd.co.pima.az.us/CPupdate/CompUpdate.htm

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

4.7 Aesthetic Resources

4.7.1 Introduction

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. This section briefly describes the existing aesthetic resources and conditions in the study area.

4.7.2 Synopsis

The view of the surrounding mountain ranges from the study area along Rillito River encompasses broad, sweeping vistas including the Santa Catalina Mountains to the north, light-colored in appearance with steep, jagged crests, the Rincon Mountains to the east, and the Tucson Mountains to the west, which are more rounded and darker in appearance. 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.

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. South of the Rillito the view is of a relatively level basin floor with urban development including higher-density development dotted with green pine and eucalyptus trees, and few native mesquite and paloverde trees.

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 road crossings are characterized by a channel (varying in width from 250 to 500 feet), and steep, soil cement banks. The river bottom consists of a small, incised low flow 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, sometimes running atop the soil cement banks. Some visible degradation of the area exists where debris have been deposited along the river bottom. Visible recreation features include pedestrian trails with a railing and pedestrian bridges over washes. In general, washes along the northern bank of the Rillito are in a natural state, while washes along the south have been channelized and cemented.

Natural vegetation communities in the study area include Sonoran desert scrub and Sonoran riparian deciduous forest, mesquite series. The riverbed is quite bare, dry and

sandy, and sparsely vegetated with small, scattered shrubs. A few small areas of the riverbed and adjacent overbank areas have small patches on cottonwood willow vegetation. The typical overbank vegetation is cottonwood willow communities and mesquite bosques, which have been degraded over the years.

4.7.3 Supporting Information

This synopsis of the aesthetic environment is based on inventory of photographs and site visits in the study area that were compiled during fact finding portion of this study. Digital or printed copies of this information may be obtained directly from the Corps of Engineers in Los Angeles.

4.8 Recreation Resources

4.8.1 Introduction

This section describes the existing recreation resources, conditions, and opportunities in the study area. This section provides an overview of the recreational resources and setting of the Tucson area, as well as the surrounding vicinity. 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 4.3, Topography and Geography; 4.4, Hydrology and Water Resources; 4.5, Biological Resources; 4.6, Land Use, and 4.7, Aesthetic Resources.

4.8.2 Environmental Setting

4.8.2.1 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.

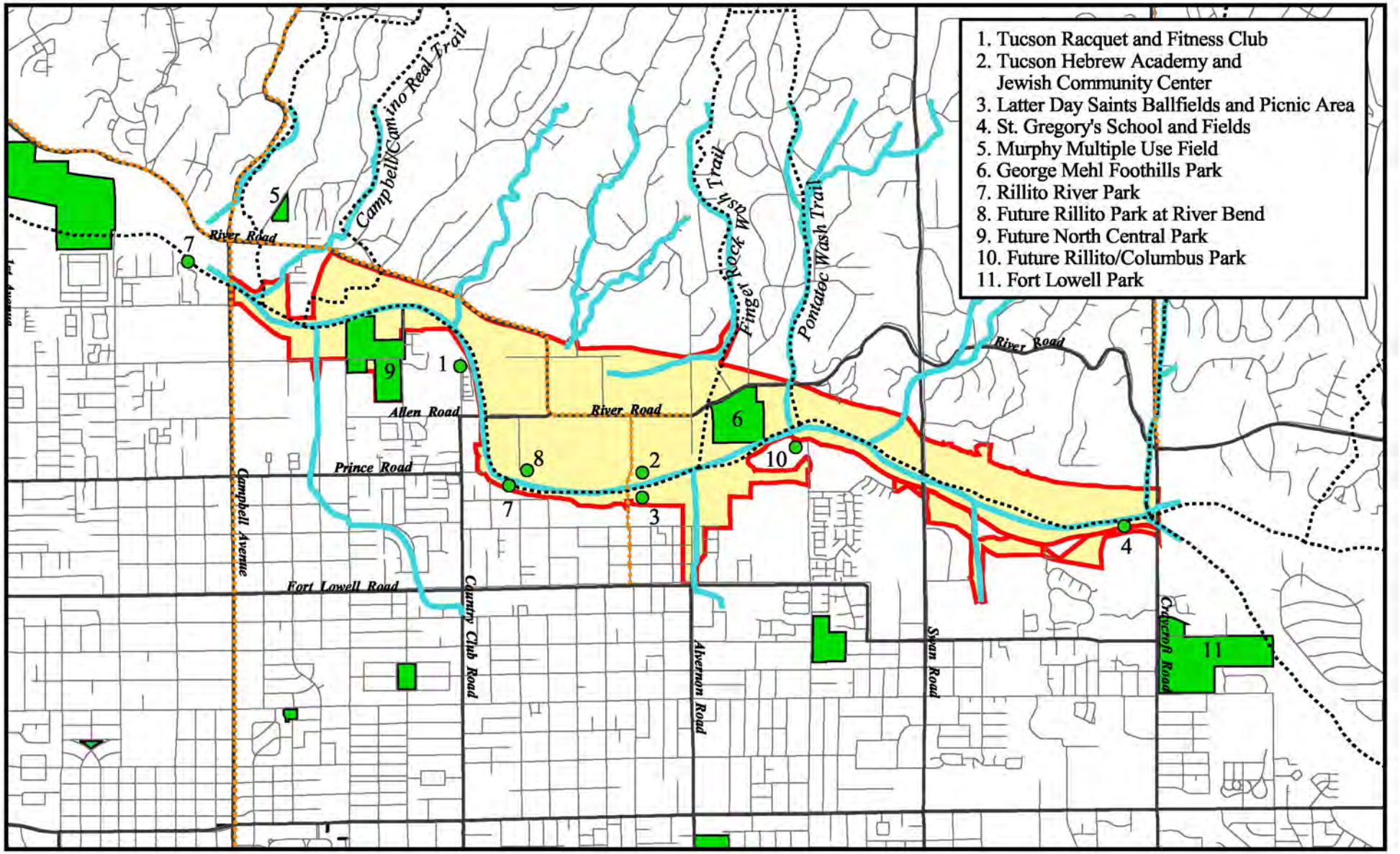
4.8.2.2 Study Area Setting

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. These facilities are listed in Table 4.8-1 with a brief description and shown in Figure 4.8-1. For a complete list of County and City parks in the Pima County/Tucson metropolitan area, please see Attachment E.

TABLE 4.8-1
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, Cañada 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).



El Rio Antiguo study area
Major Streets
Minor Streets
Recreation Facilities
Bike Path
Trail
Wash

N 0 Miles 0.6

FIGURE 4.8-1
Recreation Resources

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There are six parks, Fort Lowell Park, La Madera Park, McCormick Park, North Central Park, Murphey Multi-Use Field, and George Mehl Foothills District Park, in close vicinity of the Rillito River in the Rio Antiguo study area, in addition to the Rillito River 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. In addition, 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. Most parks would link to the Rillito River and include Campbell Alvernon Linear Park, Rillito Park at River Bend, Rillito Park at Columbus Boulevard District Park, and North Central Natural Resource 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. 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 would 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 Cañada del Oro Wash. 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.

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.

4.8.2.3 Population Growth and Recreation Demands

Tucson, along with Arizona and the Southwest, is one of the fastest growing regions in the United States. 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.

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 that are conveniently close to home. 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. In addition to being conveniently located, the Rillito River area is also accessible. There are several major roadways and trails that intersect the study area. This combination provides a park area in a high-demand area with access not only by automobile but also by pedestrians and equestrians.

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.

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. This potential illustrates how restoration of hydrology and biological resources are linked to improvements in aesthetics and recreation resources.

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, appendix to the Feasibility Study Main Report. In general, the recreation analysis in Appendix H indicates that there is a lack of sufficient recreation resources for all types of parks. Table 4.8-2 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.

4.8.2.4 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. Details of this analysis for the Rillito River area are discussed further in Appendix H, Economics, appendix to the Feasibility Study Main Report.

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.

4.8.3 Regulatory Setting

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

4.8.3.1 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

TABLE 4.8-2
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	2½ 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 2004, Rillito River, Pima County, Arizona, El Rio Antiguo Feasibility Study, Economic Appendix H. March.

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 and recreation enjoyable than a degraded ecosystem devoid of flora and fauna.

4.8.3.2 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

The Regional Vision for 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.

b. Element 14: Environmental Planning and Conservation

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.

c. Livable Tucson Goals: Indicators of a Livable Tucson

The purpose of the Livable Tucson Vision Program, introduced in 1997, is to identify a long-term, community-driven vision for Tucson that will help to shape the City's budget and provide a framework for developing programs and services that address the real concerns of the community. The program includes 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. These goals have been incorporated into the General Plan.

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 would 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.

4.8.4 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.

no date Tucson Parks and Recreation Master Plan 2010.

U.S. Army Corps of Engineers

2004 Rillito River, Pima County, Arizona, El Rio Antiguo Feasibility Study, , Economics, Appendix H. March.

U.S. Census Bureau
2002 Summary File 2 Data for Arizona, Year 2000. March.

4.9 Air Quality

4.9.1 Introduction

This section briefly discusses the general climate, meteorology, and ambient air quality in the study area.

4.9.2 Synopsis

The Tucson area is situated in a high desert valley surrounded by four mountain ranges. 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 centimeters) annually. Rainfall comes mostly during the summer monsoon season. In general, the prevailing winds blow from the southwest at an average of about eight miles an hour.

The purpose of the Clean Air Act (CAA) is to maintain healthy air quality by controlling air pollution. Criteria pollutants monitored under the CAA include carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2), and lead (Pb). These pollutants can impair health, harm the environment, and cause property damage. Two air planning areas have been designated in eastern Pima County, Rillito Planning Area (RPA), which spans the northwest portion of Pima County, and the Tucson Air Planning Area (TAPA), which spans metropolitan Tucson and the surrounding area. Designating air "areas" is somewhat arbitrary and the boundaries are approximate. The El Rio Antiguo study area is within the TAPA.

Tucson is the largest city in the country in attainment for all criteria pollutants. For CO, the TAPA 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 TAPA is still in attainment. The exceedances were flagged as natural events, and a Natural Events Action Plan is currently being developed. The TAPA is currently in attainment for O_3. While ozone concentrations are relatively steady, the levels are slowly approaching the National Ambient Air Quality Standards (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 RPA continues to be in non-attainment for PM_{10}. The El Rio Antiguo study area lies entirely within the TAPA, and the RPA is located at least 15 miles to the northwest. Given the distance between the study site and the RPA, the PM_{10} non-attainment status is

not expected to have substantial impact on the feasibility study for El Rio Antiguo, although the non-attainment status for PM_{10} would certainly be taken into consideration.

4.9.3 Supporting Information

This synopsis of the air quality environmental setting draws explicitly from an inventory of air quality reports in the study area that were reviewed during the fact-finding portion of this study. Digital or printed copies of that information may be obtained directly from the Corps of Engineers in Los Angeles.

4.10 Noise

4.10.1 Introduction

Judgments about the acoustic environment cannot be separated from human perception and, in the end, can only be quantified by intensity of sound, i.e., the auditory response to acoustic energy, not the aspects which make an array of sounds desirable (or not) to listen to. Sounds originate from natural sources and human activities (especially those associated with commerce and transportation, recreation, and entertainment), and are perceived by the human ear as an amalgam of pitches, overtones, and degree of loudness. People hear sounds, and thus are regarded as receptors whose behavior may be influenced by the acoustic environment. Animal species which rely on communication by sound for their respective behavioral reactions—fish, birds, mammals, probably some reptiles, and possibly some insects—also constitute receptors.

4.10.2 Synopsis

Six separate measurements of sound intensity were made at three locations immediately adjacent to the Rillito River 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. Each yielded the average intensity of all sounds recorded over a 15-minute period. The measured acoustic energy levels range from approximately 47 to 61 A-weighted decibels average sound level (dBA L_{eq}). These observations characterize the interior portions of the study area as being as loud as normal conversation, even where traffic crosses bridges. As expected, averaged sound levels decreased farther away from traffic and roads.

4.10.3 Supporting Information

This synopsis of the acoustic environmental setting draws explicitly from an inventory by parcel of human receptors, average daily traffic counts on roads in the study area, and general cognitive studies of the human ear and sound perception. They were compiled during the fact-finding portion of this study. Digital or printed copies of that sound and receptor inventory may be obtained directly from the U.S. Army Corps of Engineers in Los Angeles.

4.11 Cultural Resources

4.11.1 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 State Historic Preservation Officers (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 Code of Federal Regulations (CFR) Part 800, *Protection of Historic Properties* (recently revised, effective January 11, 2001).

The proposed action is considered an undertaking, and therefore must comply with the NHPA. The NHPA (36 CFR Part 800) 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. The National Environmental Policy Act addresses compliance with the NHPA, and the required environmental documentation, whether it be an environmental assessment or on environmental impact statement, must discuss cultural resources. It is important to recognize however, that project compliance with NEPA does not mean the project is in compliance with the NHPA.

According to NHPA (36 CFR Part 800), 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. All three steps require consultation with interested Native American Indian tribes, local governments, and other interested parties.

4.11.1.1 Identification and National Register Historic Places Evaluation

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

The Historic Sites, Buildings and Antiquities Act of 1935 required the survey, documentation, and maintenance of historic and archaeological sites in an effort to determine which resources commemorate and illustrate the history and prehistory of the United States. The NHPA expanded on 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 Part 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.

4.11.1.2 Results of Identification and Evaluation

Results of literature searches, field surveys and tribal consultation are coordinated with the SHPO staff. 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 which may be affected by the undertaking, the agency will make a "historic properties affected" determination.

4.11.2 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.

4.11.3 Resolution of Adverse Effects

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, local governments, 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).

4.11.4 Cultural Resources (Existing Conditions)

4.11.4.1 Cultural Background

The Tucson Basin has been witness to human activity for over 10,000 years. The prehistory and history of the Tucson Basin is described chronologically. Human occupation is divided into periods, and then again into phases (Table 4.11-1). 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.

As large scale irrigation agriculture developed in the succeeding Formative period, the pace and complexity of culture change increased dramatically. The Formative Stage 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.

The largest prehistoric village in proximity to the study area is the Hardy Site (AZ BB:9:14 [ASM]). The site was occupied from A.D. 650 (Snaketown Phase) to A.D. 1200 (Tanque Verde Phase) (Gregonis 1997:3). Smaller sites near the study area include AZ BB:9:54, a Rincon phase habitation site excavated by ASM in 1982 (Huntington).

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

In the late 19th century, Mormons entered the Tucson Basin having returned to America from Mexico as a result of civil unrest associated with the Mexican Revolution. Nephi Bingham and his extended family bought property along the Rillito ca. 1898. Additional Mormon families moved to the property area in 1908 creating the community of Binghampton (O'Mack et al. 2002:134). Binghampton thrived as a Mormon community for approximately 40 years. In addition to houses, a school, cemetery, and substantial irrigation features were constructed. Binghampton was recorded as a historic site in 1989 (AZ BB:9:238 [ASM]). The Corps of Engineers determined Binghampton eligible for listing in the National Register of Historic Places in 1992 under criterion a (association with events that have made a significant contribution to the broad patterns of our history), criterion b (association with the lives of persons significant in our past), criterion c (the embodiment of distinctive characteristics of a type, period or method of construction), and criterion d (potential to yield information important in prehistory and history). Binghampton's most visible importance is the high integrity of the rural landscape. Binghampton was nominated for listing in the National Register in 2001.

According to historic maps, the project area involving the north side of the Rillito, including the community of Binghampton, was sparsely developed until recent times. Historic redwood water conveyance systems associated with the Rillito River, including the Santa Catalina Ditch and Irrigation Company flume (ca. 1886) and Davidson's flume (ca. 1894) are in the study area. A portion of Davidson's flume was discovered during construction of the Corps' Rillito River Bank Protection project. In 1995, the Corps determined the flume system eligible for listing in the National Register, and implemented mitigation (documentation) (Sterner 1996).

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 17th 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 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 the traditional linguistic term Tohono O'odham is now employed. The prehistoric Hohokam are probably genetically and culturally connected to 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.

4.11.4.2 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).

TABLE 4.11-1
CHRONOLOGICAL CULTURAL OVERVIEW OF THE TUCSON BASIN

	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	(Hohokam)	CLASSIC	Tucson
A.D. 1300			
A.D. 1200			Tanque Verde
A.D. 1100			
A.D. 1000		SEDENTARY	Late Rincon
A.D. 900			Middle Rincon
			Early Rincon
A.D. 800	FORMATIVE	COLONIAL	Rillito
A.D. 700			Canada del Oro
A.D. 600		PIONEER/EARLY FORMATIVE	Snaketown
A.D. 500			Early Broadline
A.D. 400			Tortolita
A.D. 300			
A.D. 100			Agua Caliente
100 B.C.	ARCHAIC	LATE ARCHAIC	Cienega
500 B.C.			
1000 B.C.			San Pedro
2000 B.C.		MIDDLE ARCHAIC	Chiricahua
			?
6000 B.C.			
		EARLY ARCHAIC	? Sulphur Springs-Ventana ?
9000 B.C.	PALEOINDIAN		

4.11.4.3 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 per cent 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 of Historic Places (NRHP) including AZ BB:9:18 (prehistoric pithouse), AZ BB:9:238 (historic Mormon settlement of Binghampton), and AZ BB:9:302 (Davidson Flume). In 1992 the Corps determined AZ BB:9:18 (ASM) and AZ BB:9:238 (ASM) to be eligible for listing in the NRHP. In 1995 the Corps determined AZ BB:9:302 (ASM) eligible for the NRHP. The remainder of recorded sites within the study area are undetermined as to NRHP eligibility, unless destroyed. Sites described as destroyed are subject to confirmation via a field check. Many of the sites in the study area can be considered potentially eligible. The following are the sites in the APE, and all site numbers are recorded in the ASM system:

SITE	DESCRIPTION	NRHP STATUS
AZ BB:9:17	Hohokam camp	Eligibility undetermined
AZ BB:9:18	Hohokam pithouse site	Eligible for NRHP
AZ BB:9:19	Hohokam site/historic	Destroyed
AZ BB:9:21	Hohokam site	Destroyed
AZ BB:9:23	Hohokam/historic ditch	Eligibility undetermined
AZ BB:9:118	Hohokam/historic ditch	Eligibility undetermined
AZ BB:9:238	Hohokam/Binghampton	Eligible for NRHP
AZ BB:9:246	Historic hearth	Eligibility undetermined
AZ BB:9:247	Historic irrigation	Eligibility undetermined
AZ BB:9:253	Hohokam camp	Eligibility undetermined
AZ BB:9:254	Historic house	Eligibility undetermined
AZ BB:9:255	Hohokam/historic canal	Eligibility undetermined
AZ BB:9:256	Historic house	Eligibility undetermined
AZ BB:9:302	Davidson Flume	Eligible for NRHP

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

4.11.5 Impacts

Preliminary project designs involving water conveyance indicate potential adverse effects to the historic setting associated with the historic town of Binghampton (AZ BB:9:238 ASM), which is eligible for listing in the National Register of Historic Places. Proposed planting along the riverbank at Binghampton may not be an adverse effect since trees

were planted historically in the same context. Once more detailed plans are available, and after consideration of buried prehistoric resources along the bank of the river, a determination of effect will be made in consultation with tribes and Pima County.

The remainder of known resources are potentially avoidable by the project. The floodplain may contain buried resources however. If additional sites cannot be avoided, they will be evaluated regarding eligibility for the National Register. All NRHP sites that will be impacted by project constructed will be mitigated. See environmental commitments and compliance sections.

4.11.6 Environmental Commitments

Qualified archeologists will perform a survey of previously unsurveyed areas within the project's area of potential effects, including Finger Rock Wash. Subsurface exploration to determine the presence/absence of buried cultural deposits may also be necessary.

If cultural resources cannot be avoided, they will be evaluated regarding eligibility for listing in the National Register of Historic Places.

Identification, evaluation, and mitigation studies will be coordinated with Pima County and interested Native American Indian Tribes.

Archeologists from Pima County and the Corps will participate in the design of water conveyance features across the landform associated with the historic town of Binghampton in an effort to minimize adverse effects.

Since it is likely that National Register listed or eligible properties will be adversely affected by the project (i.e., Binghampton), a Memorandum of Agreement will be negotiated with the Arizona State Historic Preservation Officer, Pima County, and interested Native American Indian tribes. An archeological site treatment plan will be developed in consultation with the SHPO, Pima County and interested Native American Indian tribes.

4.11.7 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. Corps identification and evaluation studies will be coordinated with Pima County and interested Native American Indian tribes. The Corps' determinations of eligibility and effect will be coordinated with the Arizona State Historic Preservation Officer. Proposed project features that currently

involve AZ BB:9:238 (ASM) (Binghampton) indicate that it is likely that National Register listed or eligible properties will be adversely affected by the project. Therefore, a Memorandum of Agreement (MOA) will be negotiated with the Arizona SHPO, Pima County, and interested Native American Indian tribes. An archeological site (historic properties) treatment plan will be developed in consultation with the SHPO, Pima County, and interested Native American Indian tribes as stipulated in the MOA. Until the field studies, consultation, and determinations of resource eligibility and project effect are completed, the project is not in compliance with the Act.

4.11.8 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 Final EIS.

The EIS was sent to the following for comment along with all identification, evaluation, and mitigation studies:

Pima County - Ms. Linda Mayro, County Archeologist

Tohono O'odham Nation – Mr. Peter Steere, Program Manager, Cultural Affairs Department

Hopi Tribe – Mr. Leigh Kuwanwisiwma, Cultural Preservation Office

Pascua Yaqui – Ms. Amalia A.M. Reyes, Language and Culture Preservation Specialist

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4.12 Hazardous and Toxic Waste

4.12.1 Introduction

A limited Phase 1 evaluation [as per American Society for Testing and Materials (ASTM) Standard for Phase I Environmental Site Assessments (Standard Designation E 1527-00)] of potential Recognized Environmental Conditions (RECs) was conducted for the entire study area. The method of research consisted of gathering and evaluating existing published and unpublished information for specific properties within the study area, examining maps, aerial photos, and other data sources for problematic past land usage, interviewing land owners, and field reconnaissance. No borings or sampling of soils or water were undertaken.

4.12.2 Synopsis

A former landfill at the north end of Columbus Avenue was abandoned in the 1980s after the City of Tucson ceased to use it. All test pits and excavations conducted previously at the site revealed only inert construction materials beneath a shallow cap. Chemical analyses of water from monitoring wells upstream and downstream of the site reveal no leachate from these materials, or presence of any substances which otherwise could contaminate groundwater.

Only three other potential RECs were disclosed within areas (or closer to them than 1,000 feet) where ground preparation would be necessary should any of the three alternatives be implemented, all on the southern edge of the bend where terrace(s) would be constructed. At each location, probably minor amounts, if any, of asbestos containing materials or petroleum contaminated soils could exist.

4.12.3 Supporting Information

This synopsis of the current hazardous and toxic waste environmental setting was abstracted from a meticulous and detailed inventory of all relevant RECs compiled during the fact-finding portion of this study. Digital or printed copies of that inventory and technical reports from which that inventory was derived may be obtained directly from the U.S. Army Corps of Engineers.

4.13 Socioeconomics

4.13.1 Introduction

An iterative economic assessment of properties, structures, and demographic characteristics within the study area, and how it itself fits in with the greater Tucson area, included field surveys, inventories, evaluations of structures, contents and potential damage, as well as emergency response and traffic damage. Field surveys included 100 percent survey by hand level. Data included relative first-floor elevation, structure type, address, the number of structures, class, number of stories, structure condition, and structure use. Inventoried floodplain structures were categorized into single-family residence, mobile home, multiple-family residence (duplex, quadraplex, mixed, condominium, or townhouse), commercial, and public (schools, government, or religious). Parks in the vicinity were also tabulated as a measure of recreational demands for the Rillito and areas adjacent to it.

4.13.2 Synopsis

The formal study area encompasses comparatively few structures of any type. Single-family residences tally highest, in the bend primarily (indicated by land use, see Figure 4.6-1). These parcels commonly have agricultural investments and/or livestock pastured around the dwelling. Two parks, a scattering of small commercial enterprises, a facility for agricultural research, and a community center with declared religious affiliation comprise most of the rest of all development inside the study area. Single-family residences prevail to the north of the study area. Commercial businesses, apartment complexes, mobile home communities, and some single-family residences are mixed amongst each other according to municipal zoning designations on the south side of the Rillito.

4.13.3 Supplementary Information

This synopsis was abstracted from a meticulous and detailed inventory of parcels, structures, valuations, and flood maps during the fact-finding portion of this study. Digital or printed copies of that inventory may be obtained directly from the U.S. Army Corps of Engineers.

4.14 Utilities

4.14.1 Introduction

In support of the El Rio Antiguo Feasibility Study, analysis of utilities in and around the study area was considered in detail. What follows below is a synopsis of the pertinent utilities in the study area.

4.14.2 Synopsis

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. Tucson Water provides water service to most city residents as well as a large number of other area communities.

Pima County Wastewater Management operates the sewer system in the metropolitan Tucson area. Some of the sewer and reclaimed water infrastructure is located 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. Discharged water from the treatment plants does not occur in the study site, and has no direct impact on the study area, so public health and safety concerns regarding treatment plants are limited.

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.

4.14.3 Supporting Information

This synopsis of utilities in the study area is based on previous investigation and analysis of the utilities in the study area that were compiled during the fact-finding portion of this study. Digital or printed copies of that sound and receptor inventory may be obtained directly from the U.S. Army Corps of Engineers in Los Angeles.

4.15 Transportation

4.15.1 Introduction

This section briefly discusses the transportation system that exists within the vicinity of the El Rio Antiguo study area. A brief description of the transportation system is provided.

4.15.2 Synopsis

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. 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. It is no surprise that most intersections having long delays also have high average daily traffic. Many of the busy intersections are congested due to both delay and traffic volume. The general traffic pattern is one of increasing traffic volumes as well as increasing delays.

In the vicinity of the study area, to the north of the Rillito River, the network of residential roads is irregular compared to the organized grid network of roads to the south. The western study area boundary is Campbell Avenue, and the eastern study area boundary is Craycroft Road. Bridges that cross the Rillito include Campbell Avenue, Dodge Boulevard, Swan Road, and Craycroft Road. River Road is the most prominent road traveling east to west through the study area.

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.

Airports within eastern Pima County include Marana Northwest Regional, Ryan Field, La Cholla Airpark, Davis-Monthan Air Force Base, and Tucson International.

4.15.3 Supporting Information

This synopsis of the transportation network in the study area is based on previous investigations and analysis of the roadway functional classification system, local roadway network, and information from the Pima County Association of Governments (PAG) including the Regional Transportation Plan, Transportation Improvement Plan, and various programs. They were compiled during the fact-finding portion of this study.

Digital or printed copies of that sound and receptor inventory may be obtained directly from the U.S. Army Corps of Engineers in Los Angeles.

4.16 Safety

4.16.1 Introduction

This section briefly discusses safety concerns in the study area. While hazardous wastes and landfills are briefly mentioned here, they are discussed in Section 4.12, Hazardous and Toxic Waste, as well as in Appendix G, HTRW, appendix to the Feasibility Study Main Report which includes the limited Phase 1 evaluation [as per American Society for Testing and Materials Standard for Phase I Environmental Site Assessments (Standard Designation E 1527-00)] for potential Recognized Environmental Conditions that was conducted for the entire study area.

4.16.2 Synopsis

Hazardous waste that may be of concern in the study area includes a former landfill at the north end of Columbus Avenue that was abandoned in the 1980s, and three potential RECs in the area. For the abandoned landfill, all test pits and excavations conducted previously at the site revealed only inert construction materials beneath a shallow cap. Chemical analyses of water from monitoring wells upstream and downstream of the site reveal no leachate from these materials, or presence of any substances which otherwise could contaminate groundwater. For the RECs, probably minor amounts, if any, of asbestos containing materials or petroleum contaminated soils could exist. These three locations are all on the southern edge of the bend where terrace(s) would be constructed.

Regarding wastewater, 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.

In the study area, the Rillito River has been channelized and its banks soil cemented for protection against damage from erosion of flood events. 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.

A network of flood and precipitation sensors warns of floods coming down the Rillito River system. Pima County has acquired properties in the river bend area for floodplain management.

4.16.3 Supporting Information

This synopsis of the safety setting in the study area is based on previous investigations and analysis compiled during the fact-finding portion of this study. Digital or printed copies of that information may be obtained directly from the U.S. Army Corps of Engineers in Los Angeles.

Chapter 5.0

Environmental Consequences of Proposed Action and Alternatives

This chapter presents an analysis of environmental consequences for the El Rio Antiguo study by comparing the expectations of future conditions under the no action alternative against those anticipated with implementation of the recommended plan, Alternative 2H. Table 5-1 presents a review of potential impacts for the proposed alternative. Table 5-2 presents a summary comparison of potential impacts for all alternatives considered in this study.

In accordance with NEPA, the effects of the proposed action are evaluated to determine if it would result in a significant adverse impact on the environment. In all subsections which follow, short-term construction-related effects; longer-term and permanent effects that would result from the actual earth-moving, bank alterations, installation of trees, and so forth required to carry out the recommended alternative; and the subsequent operation and maintenance of the project for 50 years are considered.

5.1 Topography and Geology

5.1.1 Equivalency of Changes Caused by Restoration Alternatives

The changes in topography and geology attributable to all three Alternatives, 2H, 2E, and 2F, would not differ materially from each other. Each would entail removal of existing soil cement from the north bank in the area of the bend, then rearranging enough native sediments currently behind the soil cement and on the existing overbank to sculpt three terraces at different heights above the river bottom. The entire acreage of terraces would be concentrated in a single locale by Alternative 2H, and require preparation of approximately 32 acres total surface area, removal of about 5,100 linear feet of soil cement, and removal off-site of approximately 215,000 yd^3 (cubic yards) of overbank alluvium and remnants of soil cement. Alternatives 2E and 2F would fashion two

TABLE 5-1
REVIEW OF POTENTIAL IMPACTS

Issue	Potential Impact (short and long term)	Rationale	Mitigation Suggestions
Topography and Geology	No	Landscape grading, reconfiguration of terrain, and shifting of dirt for terraces and basins would occur, but would not constitute a significant impact.	–
Hydrology and Water Resources	Yes	Most changes in hydrology would be done in order to achieve ecosystem restoration objectives. Significant impacts would likely be beneficial.	Implementation of Best Management Practices (BMP) during construction to reduce the unwanted increase of sediments.
Biological Resources (wildlife and plants)	Yes	Short-term temporary effects may include temporary disturbance of vegetation and wildlife during construction activities that can be avoided or minimized with appropriate mitigation. No federally listed species occur in the project area; therefore, no significant impacts would occur from construction. There would be significant beneficial long-term impacts to biological resources including benefits to species with the restoration and improvement of the ecosystem. Long-term benefit for wildlife would occur due to an increase of suitable habitat and water availability for small mammals, reptiles, invertebrates, and migratory and resident birds, including raptors.	Implementing BMPs would minimize potential harm to wildlife during construction. Timing of construction outside the breeding season of February 15 to August 31 would minimize impacts to birds (i.e., heavy construction should occur from September 1 to February 14). If work would occur during the nesting period, nest surveys should be conducted prior to construction. Construction activities should avoid impacts or disruptions to nests until young have fledged.
Land Use	No	Any change to land use would occur outside of this restoration study. Parcels under private ownership are expected to be developed.	–

TABLE 5-1
REVIEW OF POTENTIAL IMPACTS
(continued)

Issue	Potential Impact (short and long term)	Rationale	Mitigation Suggestions
Aesthetic Resources	Yes	The visual surroundings would improve from the restoration of vegetation communities and resulting increase in bird and other wildlife populations. The scenic quality of the river corridor, particularly for pedestrians, bicyclists, and equestrians would be expected to be greatly improved.	–
Recreation Resources	Yes	Potential short-term temporary impacts would occur to recreation paths due to construction. Recreation opportunities such as bird watching and other benefits from the restored ecosystem would be improved. Beneficial significant impacts include an increase in recreation amenities including additional parking, pedestrian bridges that increase trail circulation, and access ramps.	Advance notification of any trail or access detour or closure due to construction would be posted. Construction would be phased and planned to minimize closure periods. This would mitigate any short-term adverse effects.
Air Quality	No	No impacts to air quality would be expected. Temporary increases in air particulates resulting from construction activities would not be significant, particularly with the implementation of BMPs.	To reduce particulate dust during construction, limit work to time period of calm winds, implement BMPs, as well as regular spraying with water to minimize construction dust.
Noise	No	A temporary increase in noise associated with construction may be expected, but not a significant impact.	Limit construction work to weekday work hours and give advance notice to adjacent residents.
Cultural Resources	Yes	All archaeological, cultural, and historic properties will be preserved when possible. When not possible, all applicable regulations will be followed.	Implementation of a Memorandum of Agreement with the Arizona State Historic Preservation Officer and interested Native American Tribes.

TABLE 5-1
REVIEW OF POTENTIAL IMPACTS
(continued)

Issue	Potential Impact (short and long term)	Rationale	Mitigation Suggestions
Hazardous, Toxic, and Radioactive Waste (HTRW)	No	No direct impacts concerning HTRW are expected. Potential issues that may warrant further consideration are properties in the bend area that could potentially have limited wastes; however, no wastes are expected to be a significant impact.	Proper disposal of typical household wastes. Strict control, maintenance, and regulation of all construction vehicles and earth-moving equipment.
Socioeconomics	No	No property owners are expected to be displaced if this project is implemented. Implementation of this project is not expected to adversely affect property values. The improved visual quality of the river corridor may enhance values of adjacent properties.	–
Utilities	No	Potential future reclaimed water uses could possibly be slightly limited due to the consumption of reclaimed water by this project if it is implemented. This is not expected to be a significant impact.	–
Transportation	No	Implementation of this project would not impact traffic.	–
Safety	No	No potential impacts concerning safety would be expected. One issue to address is the possibility of soil cement removal to construct terraces in the bend. This is not expected to result in a significant impact.	Implementation of BMP and safety measures would alleviate safety concerns during construction.

TABLE 5-2
SUMMARY COMPARISON OF ALTERNATIVES

	No Action	Alternative 2e	Alternative 2f	Alternative 2h
1. PLAN DESCRIPTION	No Action/Without Project Condition	2 Sets of terraces, known as the "Bend" Eight upstream basins Rillito low and high flow channel restoration Expanded and improved buffer areas Buffer areas enhanced with plantings 12 in-channel gabions for additional restoration Cottonwood/willow, mesquite, shrub and grasses planted in the channel, in tributary mouths, and in water harvesting basins on the tributaries	2 sets of terraces, known as the "Bend" Eight upstream basins Rillito low flow channel restoration 12 in-channel gabions for additional restoration Cottonwood/willow, mesquite, shrub and grasses planted in the channel, in tributary mouths, and in water harvesting basins on the tributaries	Set of terraces, known as the "Bend" 8 upstream basins A high and low-flow channel that supports mesquite habitat and joins the Finger Rock Wash with the Rillito River A distribution system for effluent supporting planted vegetation until established and in dry periods 12 gabions Cottonwood/willow, mesquite, shrub and grasses planted in the channel, in tributary mouths, and in water harvesting basins on the tributaries
2. ENVIRONMENTAL IMPACT ASSESSMENT				
(1) Topography and Geology	Soil cement would not be removed for creation of terraces. The bend area would remain in its current state. No rearrangement of sediments at the washes would occur.	Landscape grading, reconfiguration of terrain, and shifting of dirt for terraces and basins would occur, but would not constitute a significant impact.	Landscape grading, reconfiguration of terrain, and shifting of dirt for terraces and basins would occur, but would not constitute a significant impact.	Landscape grading, reconfiguration of terrain, and shifting of dirt for terraces and basins would occur, but would not constitute a significant impact.
(2) Hydrology and Water Quality	Existing water quality is poor due to the high levels of certain pollutants, and will most likely remain poor.	Water quality may decrease temporarily due to construction. Best Management Practices will be implemented for mitigation. However, positive impacts over current conditions may occur in the long term.	Water quality may decrease temporarily due to construction. Best Management Practices will be implemented for mitigation. However, positive impacts over current conditions may occur in the long term.	Water quality may decrease temporarily due to construction. Best Management Practices will be implemented for mitigation. However, positive impacts over current conditions may occur in the long term.
(3a) Biology: Acres Restored	No acres restored.	Projected increase of 345 acres.	Projected increase of 289 acres.	Projected increase of 284 acres.
(3b) Biology: Incidental Acres Improved	No acres restored.	Estimated increase of 107 acres of improved river bottom.	Estimated increase of 107 acres of improved river bottom.	Estimated increase of 107 acres improved river bottom.

TABLE 5-2
SUMMARY COMPARISON OF ALTERNATIVES
(continued)

	No Action	Alternative 2e	Alternative 2f	Alternative 2h
(3c) Biology: Wildlife Habitat	Area is potential habitat to 18 Pima County Species of Interest. Vegetation is sparse and habitat is degraded in most places. Habitat will likely continue to degrade even more.	Wildlife habitat my decrease during construction; however, mitigation of Best Management Practices will be implemented. Wildlife habitat quality will improve with plantings and water in the long term (see Acres restored and Incidental Acres Improved).	Wildlife habitat my decrease during construction; however, mitigation of Best Management Practices will be implemented. Wildlife habitat quality will improve with plantings and water in the long term (see Acres restored and Incidental Acres Improved).	Wildlife habitat my decrease during construction; however, mitigation of Best Management Practices will be implemented. Wildlife habitat quality will improve with plantings and water in the long term (see Acres restored and Incidental Acres Improved).
(3d) Biology: Overall Ecosystem Function Restored (Average Annual Functional Capacity Units, AAFCU)	No improvement would occur in terms of ecosystem functionality.	In terms of ecosystem function assessment, the project would improve the ecosystem function by a net gain of 125 AAFCU.	The project would improve the ecosystem function by a net gain of 123 AAFCU.	The project would improve the ecosystem function by a net gain of 120 AAFCU.
(4) Land Use	No change to existing land uses. Parcels under private ownership are expected to be developed independently of this project.	Parcels under private ownership are expected to be developed independently of this project. Some improvement in property values may occur.	Parcels under private ownership are expected to be developed independently of this project. Some improvement in property values may occur.	Parcels under private ownership are expected to be developed independently of this project. Some improvement in property values may occur.
(5) Aesthetics	The views from and of the study area include: from the northern river boundary - the Santa Catalina Foothills; from the Foothills, the Rillito River, featuring natural washes, and recreation areas along the river; from the southern boundary, a bustling metropolitan area, and; from the Dodge Boulevard Bridge, a Tucson Electric Power Substation. The view of the river is characterized by soil cement, Sonoran mixed scrub and weeds, debris (household trash, tires, etc) and utility poles. These conditions would continue and possibly increase.	During construction, aesthetics may be adversely affected; however, many of these areas are not highly visible and the adverse effects are short term. The implementation of 2e would eventually result in improved aesthetic views of riparian vegetation. This alternative would have the largest increase in restored acres and therefore the greatest area of visually pleasing habitat.	During construction, aesthetics may be adversely affected; however, many of these areas are not highly visible and the adverse effects are short term. The implementation of 2f would eventually result in improved aesthetic views of riparian vegetation.	During construction, aesthetics may be adversely affected; however, many of these areas are not highly visible and the adverse effects are short term. The implementation of 2h would eventually result in improved aesthetic views of riparian vegetation.

TABLE 5-2
SUMMARY COMPARISON OF ALTERNATIVES
(continued)

	No Action	Alternative 2e	Alternative 2f	Alternative 2h
(6) Recreation	No change.	Will increase carrying capacity of existing trail system and accessibility. Also will restore habitat, which in turn will expand recreation opportunities.	Will increase carrying capacity of existing trail system and accessibility. Also will restore habitat, which in turn will expand recreation opportunities.	Will increase carrying capacity of existing trail system and accessibility. Also will restore habitat, which in turn will expand recreation opportunities.
(7) Air Quality	Normal air quality levels created by business, traffic, and industrial activities.	Temporary air quality will decrease due to construction. This will be mitigated through the implementation of Best Management Practices. However, this alternative may have positive long-term impacts when compared to the no action alternatives.	Temporary air quality will decrease due to construction. This will be mitigated through the implementation of Best Management Practices. However, this alternative may have positive long-term impacts when compared to the no action alternatives.	Temporary air quality will decrease due to construction. This will be mitigated through the implementation of Best Management Practices. However, this alternative may have positive long-term impacts when compared to the no action alternatives.
(8) Noise	No future changes to the noise environment are anticipated, except for localized, temporary construction noise that would occur for typical development activities. Basically, there would be no difference in the noise environment between the No Action and the project alternatives.	A temporary, but not significant increase in noise associated with construction may be expected. Construction work would be limited to weekday work hours and advance notice given to adjacent residents. There would be less ambient noise in restored areas.	A temporary, but not significant increase in noise associated with construction may be expected. Construction work would be limited to weekday work hours and advance notice given to adjacent residents. There would be less ambient noise in restored areas.	A temporary, but not significant increase in noise associated with construction may be expected. Construction work would be limited to weekday work hours and advance notice given to adjacent residents. There would be less ambient noise in restored areas.

TABLE 5-2
SUMMARY COMPARISON OF ALTERNATIVES
(continued)

	No Action	Alternative 2e	Alternative 2f	Alternative 2h
(9) Cultural Resources & Historic Properties	Archaeologists have counted 14 sites over the area of potential effects (APE). Three of the fourteen are eligible for the National Register.	Complete avoidance of these resources may be unsuccessful during the construction period. Therefore, a Memorandum of Agreement would be negotiated with the Arizona State Historic Preservation Officer and interested Native American Tribes. All archaeological, cultural and historic properties will be preserved as best as possible and the recontour in the bend will add a historic appearance.	Complete avoidance of these resources may be unsuccessful during the construction period. Therefore, a Memorandum of Agreement would be negotiated with the Arizona State Historic Preservation Officer and interested Native American Tribes. All archaeological, cultural and historic properties will be preserved as best as possible and the recontour in the bend will add a historic appearance.	Complete avoidance of these resources may be unsuccessful during the construction period. Therefore, a Memorandum of Agreement would be negotiated with the Arizona State Historic Preservation Officer and interested Native American Tribes. All archaeological, cultural and historic properties will be preserved as best as possible and the recontour in the bend will add a historic appearance.
(10) Hazardous and Toxic Waste	There would be no difference between the No Action and the project alternatives.	No impacts concerning hazardous and toxic wastes. Properties potentially containing limited wastes are outside the project area.	No impacts concerning hazardous and toxic wastes. Properties potentially containing limited wastes are outside the project area.	No impacts concerning hazardous and toxic wastes. Properties potentially containing limited wastes are outside the project area.
(11) Socioeconomics	There would be no difference in socioeconomics between the No Action and the project alternatives.	Implementation of this alternative would impact a stable and a nursery business. No other impact to property values, employment opportunities, housing or business are anticipated.	Implementation of this alternative would impact a stable and a nursery business. No other impact to property values, employment opportunities, housing or business are anticipated.	Implementation of this alternative would not displace any property owners, decrease property values, or alter opportunities for employment, housing, or business.
(12) Utilities	Reclaimed water would not be used for restoration purposes related to the projects.	Potential future reclaimed water uses could possibly be slightly altered due to the consumption of reclaimed water by this alternative.	Potential future reclaimed water uses could possibly be slightly altered due to the consumption of reclaimed water by this alternative.	Potential future reclaimed water uses could possibly be slightly altered due to the consumption of reclaimed water by this alternative.
(13) Transportation	There would be no difference between the No Action and the project alternatives.	Implementation of this alternative would not impact transportation. Recreational traffic and trails and would be improved.	Implementation of this alternative would not impact transportation. Recreational traffic and trails would be improved.	Implementation of this alternative would not impact transportation. Recreational traffic and trails would be improved.

TABLE 5-2
SUMMARY COMPARISON OF ALTERNATIVES
(continued)

	No Action	Alternative 2e	Alternative 2f	Alternative 2h
(14) Safety	There would be no difference between the No Action and the project alternatives.	Removal of soil cement to construct terraces would not affect safety concerns. Construction of the terraces would not increase the potential for flooding. Public safety for recreationalists would be improved with safer, wider trails.	Removal of soil cement to construct terraces would not affect safety concerns. Construction of the terraces would not increase the potential for flooding. Public safety for recreationalists would be improved with safer, wider trails.	Removal of soil cement to construct terraces would not affect safety concerns. Construction of the terraces would not increase the potential for flooding. Public safety for recreationalists would be improved with safer, wider trails.

separate terraces, divided into an upstream and a downstream part with a gap about 1,000 feet long between them; the upstream terrace approximately 13.5 acres in size (about 2,250 linear feet of soil cement) and the downstream approximately 29.5 acres (4,075 feet of soil cement)—43 acres and 7,325 linear feet of existing soil cement in total. Together, these would necessitate off-site removal of approximately 290,000 yd^3 of alluvium from the existing overbank and soil cement debris. In either case, very localized redistribution of existing overbank sediments would taper off and end a short distance from the river bottom where floodplain sediments already exist and effectively equivalent, minute topographic alterations would be implemented for all three restoration alternatives to form the terraces. Alternatives 2E and 2F would create paired terraces about 30 percent larger in effective surface area than Alternative 2H. Formation of basins where vegetation would be planted at the mouth of nine tributary washes would redistribute existing sediments in exactly the same way and the same amount for each restoration alternative. These eight, together with surface preparation necessary along Finger Rock Wash, would entail approximately 10 acres total surface area and removal off-site of approximately 242,000 yd^3 of unconsolidated sediments and native alluvium.

5.1.2 No Action (Future without Project)

No purpose for removal of soil cement or for creation of terraces would exist under No Action. Banks and overbanks at the bend would remain in their current state. Similarly, no rearrangement of sediments at the washes would be required.

5.1.3 Minor Consequences of Restoration Alternatives

These changes would not alter in any meaningful way the topography of the bend, or the Rillito itself. These changes would create a natural feature common to unfettered watercourses, that is, benches corresponding to different flood depths, scour and depositional patterns of sediment movement. The resulting change in geological character of the bend would be very minor and incidental in nature. Changes implemented where washes join the Rillito would be equally inconsequential to topographic relief or distribution and properties of alluvial sediments within the study area.

No impacts to local or regional landform or geological features would be anticipated by implementation of any of the three alternatives, comparing foreseeable effects of these alternatives against the future conditions which would prevail in the absence of a project.

5.2 Hydrology/Water Resources

5.2.1 Impact Significance Criteria

Probable changes brought about by the restoration alternatives include short- and long-term effects upon turbidity, water quality, minor changes of watercourses, and soil moisture content. The assessment of hydrologic impacts assumes that sound engineering practices would be employed.

Significant adverse impacts would result if the no action alternative or recommended plan would:

- substantially degrade water quality;
- degrade or contaminate a public water supply, including groundwater;
- substantially degrade or deplete groundwater resources, including interference with groundwater recharge or direction and rate of groundwater flow;
- cause substantial erosion or aggradation; or
- substantially change absorption rates, drainage patterns, or the rate and amount of surface runoff.

5.2.2 Environmental Impacts

5.2.2.1 Equivalency of Changes Caused by Restoration Alternatives

A decision to implement any of the three restoration alternatives would cause localized changes in flow patterns in the river bottom, a resumption of periodic flows on select overbank areas, an increase in soil moisture content, aggradation patterns both in the river bottom and on select overbank areas, and changes in water quality. By design, all three alternatives would facilitate ecologically appropriate changes in hydrologic functions commensurate with the desired ecosystem restoration and study objectives.

The amount of change in the ecological properties of the Rillito within the study area is best quantified by the functional capacity indexes of five of the eleven ecological process combined in the EFA model (four hydrological in character and one linking both hydrology and nutrients in biological communities). The measure of improvement predicted for each of these five processes reflects partial qualitative attainment (and substantial quantitative change) of these project objectives (Table 5.2-1).

The net changes summarize the difference between the projection of each alternative and the future without project. The greatest net increases occur in processes 4, 6, and 2

TABLE 5.2-1
NUMERICAL RESULTS FOR ECOSYSTEM FUNCTIONAL ASSESSMENT OF ECOSYSTEM RESTORATION ALTERNATIVES ON ECOLOGICAL PROCESSES IMPORTANT TO THE PROJECT

Ecological Process Used in EFA	Net Change of FCI; Alternatives 2E, 2F, & 2H	% Change of FCI; Alternatives 2E, 2F, & 2H	Summary of Alternatives Features Contributing Directly and Indirectly to Changes of Ecological Processes within the Project Area
1) Water flow shapes bed, banks, and overbanks of the Rillito	0.24, 0.24, & 0.24	712%, 712%, & 721%	Terraces would afford high water a chance to reshape the ground in areas planted with native species adapted to that nature of periodic disturbance. The same geomorphic alterations would happen upstream of Swan, when water gets high enough to reach the outflow channel and run behind the soil cement to the mesquite thicket on the north bank.
2) Surface feature slow and catch water	0.28, 0.28, & 0.28	156%, 156%, & 156%	Sediments and stout woody debris would settle out behind gabions placed strategically in the river bottom, creating localized pockets favoring water retention on the surface. Larger trees and shrubs in the channel also would slow and hold water temporarily at the surface. Basin constructed in tributaries would catch runoff and retain it long enough to soak in.
3) Retention of water on or immediately below the surface	0.25, 0.25, & 0.25	183%, 183%, & 183%	Combined influence of the two processes above would slow it and cause water to linger. The longer water remains available, the more it can infiltrate to the upper region of the saturation zone
4) Percolation of water to deeper soil layers and water table	0.48, 0.48, & 0.47	5938%, 5938%, & 5925%	Effective recharge of deeper aquifers is unlikely, primarily because water brought into the project would be sufficient to sustain the plants, but not enough to add materially to the regional balance between infiltration and withdrawal.
5) Transport of nutrients and carbon compounds into ecosystem	0.40, 0.40, & 0.40	521%, 525%, 524%	Application of reclaimed water by flood irrigation would simulate more natural flow patterns. Irrigation would be designed to supply enough water for an immediate area to mimic that process in historic riparian communities. The effect would be limited in extent because the water applied will only go so far before percolating entirely into the sediments.

(where functional capacity indices rise as much as 0.48); processes 2 and 1 create less quantitative difference (a change of FCI equal to 0.39 and 0.27, respectively). Percentage increases of FCI would seem to be astonishingly large, but in actual cause have more to do with lamentably poor, existing ecological conditions; hence, very low FCI values. The future without project would have them continue, and decline somewhat. Consider process #4 as an example: dividing a relatively large number (net change in FCI = 048) by a relatively small number (future without project FCI = 0.008) gives a 60-fold arithmetic factor of increase! All five processes would get much better with implementation of an alternative, but the apparent relative increases can be misconstrued. Despite that oddity of percentage increases, the improvement in ecologically relevant processes would mean important changes in overall ecological functioning of the Rillito.

First, implementation of the terraces would restore the hydrologic connection between the river channel and those particular overbank areas where installed at the bend and at the mesquite bosque at Swan Road. Vegetation at these locations would provide a desirable place for retention of nutrients carried in by fine sediments and subsequent improvement of water quality. In addition, the flows from the Finger Rock Wash low flow channel would spread out across the terraces before reaching the Rillito. This would also improve desirable sedimentation and improve water quality. So, the terraces would improve runoff characteristics from Finger Rock Wash and increase retention of nutrients on the overbank by deposition of fine sediments, thereby improving water quality from that source as well as the Rillito itself. Indirectly, those hydrological effects also would influence the nutrients available from materials carried by periodic flows to the plants installed on the terraces. Despite the removal of soil cement necessary to install the terraces in the bend area, the highest terrace would retain the bank stabilization characteristics necessary to maintain the floodplain that the current soil cement bank retains today. Indeed, construction of terraces would widen the channel, as it was historically, without compromising the containment of river flow for flood control purposes, since the river flow would be contained within the upper limits of the highest terrace and velocities would be less within the outer bank areas due to there being more area to convey the flows. The alternatives would each mimic the natural and historic hydrologic regime, likely a few seasons of aggradation of fine sediments and nutrients followed by periodic scouring when the Rillito flows near its design capacity, yet avoiding any tendency to interfere with channel conveyance. Widening the channel in the bend area to accommodate terraces would not diminish the Rillito's design conveyance capacity, hence fashioning terraced banks where soil cement now exists would not cause a significant impact to the floodplain.

Second, implementation of the basins where tributary washes already join the Rillito would improve water absorption into the soil and provide a place for desirable sedimentation. The basins would act as a "catch" pool for runoff from washes and tributaries. The modified weir across each tributary wash would slowly release the water, and soil moisture content at these basins would rise. Steady application of flood

irrigation would mean damper soils over a wide area. However, this increase in infiltration would not be enough of an improvement to replenish groundwater levels because of continuing groundwater pumping in the area. The basins would improve water quality by providing a place for sedimentation and by providing plant communities to filter the water; therefore, basins would have a significant beneficial impact on water quality. The basins would have no impact on the floodplain in the study area. In many areas where basins are being constructed, the shape of the basin already exists and is flooded during rain events. The implementation of the basins under all three restoration alternatives would not induce flooding or expand the floodplain.

Third, gabions built in the river bottom would have beneficial effects by nudging stream flows in preferred directions and protecting vegetation communities. The vegetation communities would filter water and improve water quality. The gabions would provide protection, as well as a shallow backwater area that increases desirable sedimentation. In this way, gabions would have significant beneficial impacts on water quality and stream flow characteristics. While gabions would increase water absorption into the soils, this also would not be enough to create a significant improvement to groundwater levels. Gabions would not have a significant effect on the floodplain. It is anticipated that during extremely high flows of the 25-year flow, the gabions would break free and be washed downstream, so there would be no increased flooding during high flows due to the gabions.

Each restoration alternative would rely on the same volume of reclaimed water to sustain vegetation communities while they become established and during prolonged droughts by flood irrigation. Increased filtration of reclaimed water from Rodger Road Wastewater Treatment Facility, to be spread by flood irrigation through restored riparian areas, may diminish phosphates, detergents, and other anthropogenic substances to a level substantially below total maximum daily loads to maintain water quality in the study area. In addition, use of this water for irrigation means that the vegetation would use and filter the water, thereby reducing the level of these substances even more. Irrigation is intended to be used as needed for the vegetation communities. Therefore, during dry periods, more irrigation would be necessary, whereas during rainy periods, the natural rainfall would supply water to the vegetation. During heavy rainfall, a surplus of water would wash through the study area, thereby removing any buildup of these undesirable substances from the soils through a “flushing” effect. So, the use of reclaimed water would not have a significant detrimental impact on water quality or groundwater.

5.2.2.2 No Action (Future without Project)

Under the no action alternative, future hydrological conditions would remain essentially the same as current conditions. Future water quality could decline slightly due to increased urbanization and concomitant increased acreage covered by impermeable surfaces expected to occur in and around the vicinity of the study area.

While periodic flood events would continue to occur, the channel of the Rillito River would receive surface runoff from surrounding areas and effectively convey flood flows. Only in rare extreme flooding events, such as the 100-year and 500-year flood events, would there be potential substantial flood impacts. This is due in part because the soil cement banks were installed primarily for erosion control. Under conditions of a 100-year flood event, the Finger Wash area would experience flood impacts. Under conditions of a 500-year flood event, the Finger Wash area, as well as the riverbend area (south of the Rillito, west of the Finger Wash area) and a portion of the area south of the Rillito between Dodge Boulevard and Craycroft Road, would experience potential flood damage impacts. In addition, under extreme flood conditions, areas of sparse vegetation and erodible soils on the banks and especially overbanks of the Rillito River would probably experience some level of erosion and flood impacts.

5.2.2.3 Significant Beneficial Impacts of Restoration Alternatives

Annual water needs for each of the three Restoration Alternatives would amount to approximately 1,500 acre-feet. Project alternatives may vary slightly in the exact amount of water consumed but would be around 1,500 acre-feet. That volume of water would not be required for the No Action Alternative.

A source with ample capacity to furnish that requirement for the restoration alternatives already exists in the supply of reclaimed water. The distribution system is already in place, and now furnishes reclaimed water for assorted consumption in the Study Area. Those uses do not even approach the current capacity. Additionally, long-term urban planning envisions substantial increases in daily volume available from the treatment facility, as rising commercial and residential needs for potable water spur more wastewater. The project's water requirement can now, and in the future, would easily be accommodated by existing and future supplies without precluding other uses for non-project opportunities. None of the Restoration Alternatives would cause foregone opportunities to use reclaimed wastewater elsewhere. Therefore no direct impact would occur. Similarly, no need to divert wastewater from elsewhere would be necessary. Therefore, no indirect impact would result.

The three restoration alternatives would be fully equivalent to each other in every respect concerning hydrology, hydraulics, and water quality. The permanent changes they would require are all important to the ecological processes which make an arid ecosystem sustainable. In this sense, all changes are therefore beneficial. Whether or not they would be significant in their magnitude cannot be determined on any independent basis. The changes would be large. The resulting biological communities would be testament to the significance of functional improvement to be implemented with any of these restoration alternatives.

5.3 Biological Resources

5.3.1 Impact Significance Criteria

The ecosystem changes envisioned by each of the restoration alternatives must be evaluated for their potential impacts on existing vegetation, wildlife, sensitive species, and basic ecological processes which have to precede ecosystem restoration. The analysis considers short-term as well as long-term effects. Short-term impacts focus on disruption to biological communities during the construction phase of the project. Long-term impacts, adverse as well as beneficial, focus on the immediate design for planted areas on the overbanks, in the mouths of washes, and elsewhere in the river bottom, supplying the water necessary to sustain these plantings, and the indirect effects of other organisms making a home along the Rillito once the basic plant communities have been created. The analysis also looks farther afield than just at impacts to biological resources of the Rillito, as though isolated by itself, by considering the regional context in which riparian ecosystems occur in the arid southwest. Evaluation of impacts considers biological resources and their regional and ecological context. Adverse impacts to biological resources are significant if one or more of the following conditions result from implementation of the project:

- Loss of habitat that is regionally unique, declining, or designated sensitive by resource agencies.
- Substantial loss of species diversity in natural vegetation and wildlife habitat.
- Loss of a critical resource used by a listed threatened or endangered species.
- Disturbances to populations or breeding areas of listed threatened or endangered species, or reductions in the foraging habitat for threatened or endangered species.
- Loss of individuals or populations of (1) a federal- or state-listed threatened or endangered species or their habitat; (2) a species proposed for listing, federal candidates for listing, or species that are regionally rare or otherwise sensitive species; or (3) endangered, rare, endemic, or otherwise sensitive species.

5.3.2 Environmental Impacts

5.3.2.1 No Action (Future without Project)

This section addresses the future biological condition of the study area as it would occur in 50 years (2058) under the no project alternative scenario. The target year for restoration implementation has been identified as 2008.

Currently the site conditions, such as ecosystem functions and biological value, in the study area are at a poor level and severely degraded. There is no longer any perennial stream flow and low-quality habitat pervades. Currently, the Rillito River flows intermittently in response to rain. There is very little groundwater recharge. Past and present groundwater pumping, along with limited groundwater recharge, contribute to significantly reduced groundwater levels. The depleted groundwater, soil cement banks, and adjacent urbanization preclude the system from natural flow and species regeneration, particularly for species dependent on natural hydrologic functions. The current hydrologic ecosystem functions are degraded due to the declining groundwater levels and the soil cement banks that disconnect the river channel water flows from the riparian communities along the banks of the river. These limited hydrologic functions would only diminish even more under the no action alternative.

The current vegetation communities have degraded biological value. The native vegetation is sparse and non-native species, such as salt cedar (*Tamarix* sp.) and giant reed (*Arundo donax*), occur which diminish the biological value of the vegetation communities as they pertain to wildlife. No sensitive wildlife species are known to occur, nor is any habitat of sufficient quality or quantity present to support them. The diversity of birds, reptiles, mammals, and amphibians is very low. Although summer rainfall supports enough standing water areas long enough for native spadefoot toads to reproduce, other native frogs, fish, and snakes dependent upon perennial water no longer occur within the project area. Under the no action alternative, these conditions would not improve, they would at best remain the same or, more likely, degrade even further.

Under the no action alternative, site conditions would, at best, remain as they currently are and continue to degrade. Increased infestation of non-native species, such as tamarisk and giant reed, would continue. These non-native species interfere with the traditional hydrologic regime in relation to native vegetation. Continued declines in groundwater, coupled with adjacent land use changes (such as disturbance and development), would result in a reduction of the water available to native vegetation. Non-native vegetation, such as tamarisk and giant reed, is more drought-tolerant and can more quickly utilize the limited available water. In addition, tamarisk tends to create saline soils beneath its canopy, further reducing the likelihood of native plant establishment. This would result in an increase of monotypic stands of non-native vegetation, further decreasing the value of biological resources and subsequent wildlife diversity. The federally listed endangered

southwestern willow flycatcher (*Empidonax traillii extimus*) is known to use dense stands of tamarisk as foraging and nesting habitat in areas where the native vegetation has been choked out of a historical breeding location. Avian species need large trees for perching, nesting, and roosting habitat, as well as for shade cover. The absence of cottonwood, willow, and other large trees in the study area is a reflection of the poor biological conditions. This trend would continue under the no action alternative and decline even further.

The lack of shade trees also limits the enjoyment of recreational opportunities, particularly during the hotter months of May through September. The lack of vegetation, in combination with the presence of dead or dying trees, also negatively impacts the visual quality and aesthetic enjoyment of the river corridor.

Under the no action alternative, even if the non-native species were somehow controlled, the future conditions would not be amenable to groundwater recharge improvement. Under the current and expected future condition, native trees and shrubs would not be able to establish, and the vegetation would improve from the current existing conditions, which are at a very poor level. No sensitive species habitat would develop and no sensitive species would establish in the study area. The diversity and numbers of birds, reptiles, mammals, and amphibians would remain low and decrease in the future. Most future bird species under the no action alternative would be those common to urban areas and not riparian habitats. The lack of vegetation would continue to have a negative impact on the visual aesthetics, provide no shade, and limit passive recreational opportunities along the river path.

5.3.2.2 Ecosystem Changes Caused by Restoration Alternatives

Each restoration alternative would bring about very considerable reappearance of ecologically adapted plant communities, the soil and moisture conditions they require, the structural properties by which communities differ from the species which inhabit them, and other emergent ecosystem traits. The amount of change in these various aspects of riparian ecosystems is best stated in the form of numeric results from seven of the eleven ecological processes combined in the EFA model. In this instance, average annualized functional capacity units, calculated merely by multiplying functional capacity indices by respective areas, are presented to reflect gains in area of different habitat types where ecological processes are at work (Table 5.3-1).

TABLE 5.3-1
NUMERIC RESULTS FROM ECOSYSTEM FUNCTIONAL ASSESSMENT MODEL OF ECOLOGICAL PROCESSES EXAMINED FOR EACH RESTORATION ALTERNATIVE; 2E, 2F, AND 2H

Ecological Process	Net Change of FCI	% Change of FCI	Net Change of AAFCU	% Change of AAFCU
5) Nutrient cycle within biotic communities	0.72, 0.72, &	608%, 608%	208.6, 210.0, & 205.7	820%,
6) Transport of nutrients and carbon compounds into ecosystem	0.24, 0.24, & 0.24	712%, 712%, & 721%	132.8, 134.0, & 131.6	846%, 853%, & 838%
7) Retention of particulate materials	0.31, 0.31,	209%, 209%,	122.3, 122.3, & 121.0	380%,
8) Diversity of species	0.49, 0.49,	445%, 447%,	169.6, 169.6, & 165.1	668%,
9) Spatial organization of biotic communities	0.50, 50,	348%, 348%,	160.9, 160.9, & 157.8	490%,
10) Contiguity of habitat and movement of species along corridors	0.19, 0.19,	57%, 57%,	98.0, 98.0, & 73.9	137%
11) Buffer distance between biotic communities and urban conditions	-0.15, -0.22	-28%, -39%	-18.0, -38.1, & -28.9	-19%,

NOTE: Entries show net change of functional capacity index (FCI), % change of FCI, net change of average annualized functional capacity units (AAFCU), and % change of AAFCU for each of the three restoration alternatives.

Under the all three restoration alternatives there would be short- and long-term improvements and significant beneficial impacts to biological resources. During the construction phase of the recommended plan, there may be temporary disturbance of existing wildlife, plants, and vegetation communities. Wildlife species using this reach of the Rillito River may be temporarily displaced or inadvertently killed during construction. However, since there are no listed or sensitive species in the study area, this would not be a significant adverse impact. In addition, implementation of mitigation measures would avoid and minimize these short-term impacts to a level of no adverse significant effects. Mitigation measures include the timing of construction outside of the breeding season or completing preconstruction surveys to identify breeding birds and establish “no work areas” during the breeding season. No adverse significant impacts to federally listed species are expected, since none are known or expected to occur in the area. Under each restoration alternative, there would be no adverse long-term impacts.

Under Alternative 2H, there would be long-term beneficial significant impacts. These beneficial significant impacts include an increase in the amount, diversity, and quality of vegetation and habitat suitable for native wildlife species, including sensitive species. The restoration of approximately 96 acres of cottonwood-willow forests, 102 acres of mesquite woodlands, and 35 acres of scrub-shrublands would be created under the recommended plan These specific project features would constitute an increase from

approximately three existing cottonwood acres to a total of 99 acres in the study area. Alternative 2H would increase the existing mesquite acres from approximately 13 acres to a total of 115 acres in the study area. In addition, the existing scrub/shrub community would be increased from approximately 58 acres to a total of 93 acres in the study area.

Under plan 2H, a single terrace with vegetation would be constructed in the bend area. The terrace would have scrub/shrub, cottonwood willow, and mesquite vegetation. The implementation of this measure would restore the hydrologic connection between the river channel and riparian communities, and these restored hydrologic functions would restore the biological ecosystem functions of these vegetation communities. The improved hydrologic regime would improve the chemical ecosystem process that benefits soils and microorganisms that are the building blocks of a healthy biological ecosystem. These ecosystem improvements, with the restoration of the vegetation communities, would result in a significant increase in the biological value of the habitat, and with this habitat improvement, subsequent benefits to wildlife would occur. The restoration of these vital vegetation communities in the terraces would result in a healthy, functioning, productive riparian ecosystem. This would be a significant beneficial impact.

The installation of 12 gabions in the river channel would significantly improve hydrologic, chemical, and biological processes. The gabions would direct low-flow, increase water filtration and water availability to vegetation, and provide a protected area for vegetation to establish and grow. The shallow, backwater areas created by the gabions would increase desirable sedimentation and improve hydrologic and chemical processes that are the building blocks of the restoration of these vegetation communities. The restored vegetation communities, including scrub/shrub and cottonwood willow, would increase suitable habitat for native amphibians and other wildlife species. The restoration of these communities would have a significant beneficial impact on biological resources.

Under the recommended plan, nine basins would be excavated where washes join the Rillito. These basins would capture water, increase infiltration, and slowly drain water via modified weirs. The draining by the modified weirs would prevent standing water, thereby eliminating the potential for a vector control problem. In the basins, vegetation communities including cottonwood willow and mesquite would be planted and improved. These vegetation communities would grow and flourish with the improved hydrologic and chemical ecosystem functions. The basins would capture and harvest water, thereby providing infiltration, enhancing soil processes, capturing sediments and decaying debris that benefits an ecosystem, and improving the vegetation and habitat value and subsequent wildlife benefits. The water that drains via the modified weirs into the river channel would serve to irrigate the restored vegetation communities in the river channel that establish by the gabions. The hydrologic, chemical, and biological processes of the basins would be linked to the restoration improvements provided by the gabions. The improvement to the biological resources would be a significant beneficial impact.

Under the implementation of the recommended plan, the existing Finger Rock Wash high and low flow channels in the bend area would be excavated, modified, and enhanced to improve hydrologic as well as biologic ecosystem functions. Mostly mesquite, and some scrub/shrub habitat, would be planted in these high and low flow channels. These channels would guide rainfall and provide water to the terraces. In addition to improving the hydrologic functions, these channels would provide valuable riparian habitat. This creation of quality riparian habitat would make important habitat corridor connections. First, these channels provide a corridor within the study area, particularly from the eastern portion of the study area to the western portion. These channels provide an alternative corridor to the terrace in the bend area. Second, these channels provide a critical link between the study area and the Santa Catalina Mountains. The connection provided by these channels through the bend area would facilitate wildlife, as well as water movement, through the washes through the foothills, extending up into the Santa Catalina Mountains. In addition, the habitat provided by the Finger Rock Wash channels provide refugia habitat. This means that during and after heavy rains, when the natural cycle of the river processes washes out some vegetation communities in the river channel (particularly during periods of very high flows), the wildlife species can use the habitat in the Finger Rock Wash channels as refugia while the river channel vegetation communities reestablish, following the natural cycle of the river.

The creation of riparian habitat along the Rillito would provide suitable foraging and resting habitat for migratory birds, bats, and insects traveling through the Tucson Basin. The created and preserved riparian habitats are expected to become more structurally complex over time; a layering of forbs, shrubs, and trees would create microhabitats for a variety of wildlife species to use. Over time, a microclimate is expected to form in the patches of riparian vegetation. Shade and an increase in habitat diversity would undoubtedly provide the local Tucson population with an improved natural area within the urban environment and would likely increase bird-watching opportunities.

The diversity of avian species is expected to increase significantly. Species such as Arizona Bell’s vireo, verdin, cardinals, Gila woodpeckers, and vermilion flycatchers may become more common in the project area as the habitat increases in quantity and quality. Once the cottonwood-willow vegetation matures, there is a potential for southwestern willow flycatchers to forage on-site. This species is not known to breed in the immediate vicinity; however, the creation of suitable habitat within their range may increase the possibility that new breeding populations would establish.

In the regional context, the recommended plan would provide a critical corridor connecting the western areas in Pima County, such as the Santa Catalina and Rincon Mountains, with the Santa Cruz River. Wildlife could travel through Pantano Wash and Tanque Verde Creeks, through the study area, and connect to the Santa Cruz River.

It is important to stress the overall importance of this recommended plan and its significant beneficial impacts in terms of content as well as context. The content of this ecosystem restoration alternative can be reflected by the overall improvement anticipated for ecosystem functions. The context of this ecosystem restoration study can be reflected in the residential and urban setting in which it lies. Despite the existing limitations in the residential and urban setting that surround this study area, the recommended plan provides a critical link as a corridor in the "big" picture of ecosystem conservation in terms of facilitating wildlife movements. When considering the geographical layout of eastern Pima County, the recommended plan provides a crucial ecosystem corridor link between Pantano Wash, Tanque Verde Creek, and mountain areas and the Santa Cruz River.

It is important to recognize that the intent of this recommended plan is not to create a pristine ecosystem; it is to restore a riverine ecosystem to function in its given setting, which in this case is a residential and urban environment. The mere persistence of this riverine ecosystem under the heavy influence of man highlights its resilience and ability to persist in the future and be restored to a better quality and more productive, sustainable ecosystem.

The key is to overlook the limitations of the context of the study area and accept this important ecosystem restoration study in the residential and urban setting that it is in and improve its critical function as a conservation corridor. The presence of soil cement banks in the study site pose limitations in some variables pertaining to functions, particularly the hydrology functions, that are difficult to overcome. Recognizing these limitations is important when considering the content, as well as the context of the restoration project. In general, the anticipated improvements in hydrologic, chemical, and biological processes, given the limitations of soil cement and the surrounding residential setting, is quite remarkable and would result in a healthy, restored ecosystem.

5.3.2.3 Alternative 2E (2 Terraces with Gabions with Buffer Areas)

Under Alternative 2E, the short- and long-term improvements and significant beneficial impacts to biological resources would be the same as Alternative 2H. The long-term beneficial significant impacts that would occur under Alternative 2E include an increase in the amount, diversity, and quality of vegetation and habitat suitable for native wildlife species, including sensitive species, which is the same as Alternative 2H.

The restoration of approximately 96 acres of cottonwood-willow forests, 102 acres of mesquite woodlands, and 35 acres of scrub-shrublands would be created under the recommended plan. These specific project features would constitute an increase from approximately three existing cottonwood acres to a total of 99 acres in the study area. Alternative 2H would increase the existing mesquite acres from approximately 13 acres

to a total of 115 acres in the study area. In addition, the existing scrub/shrub community would be increased from approximately 58 acres to a total of 93 acres in the study area.

5.3.2.4 Alternative 2F (2 Terraces with Gabions without Buffer Areas)

Under Alternative 2F, the short- and long-term improvements and significant beneficial impacts to biological resources would be the same as Alternative 2H. The long-term beneficial significant impacts that would occur under Alternative 2F include an increase in the amount, diversity, and quality of vegetation and habitat suitable for native wildlife species, including sensitive species, which is the same as Alternative 2H.

The restoration of approximately 96 acres of cottonwood-willow forests, 102 acres of mesquite woodlands, and 35 acres of scrub-shrublands would be created under the recommended plan. These specific project features would constitute an increase from approximately three existing cottonwood acres to a total of 99 acres in the study area. Alternative 2H would increase the existing mesquite acres from approximately 13 acres to a total of 115 acres in the study area. In addition, the existing scrub/shrub community would be increased from approximately 58 acres to a total of 93 acres in the study area.

5.4 Land Use

5.4.1 Equivalency of Changes Caused by Restoration Alternatives

The three restoration Alternatives, 2E, 2F, and 2H, each center on transforming overbank lands along the north side of the bend into terraces, creating small basins in the lower end of washes, and fashioning gabions in the river bottom. The three would have nearly identical effects. The areas where these measures would be implemented are entirely within, or adjacent to, the existing channel, and along the depositional plain of Finger Rock Wash, and would remain consistent with the current land use designations and zoning. Formation of terraces (and installing native plant communities on the terraces) would limit opportunities for future modifications of properties, such as corrals and outbuildings for storage of feed and equipment, if current property owners were to retain title. A decision to implement any of the three would necessitate acquisition of requisite lands or conservation easements at fair market value. Aside from that conversion of acreage now used agriculturally to restoration of native habitat, the three alternatives would remain compatible with existing and future land uses, would not disrupt the river bend community, and would not result in a permanent disruption of land use for agricultural activities. Alternatives 2E and 2F would differ slightly from Alternative 2H in that the two terraces would incorporate about 12 acres more overbank lands than 2H; 43 and 31 acres, respectively. Any land use changes, for example, the creation of a park in the bend area, would occur independently of this project. As example, Pima County's plan for the River Road project and any plans for a County park would still occur. These are within the designated land uses in the study area and would have no significant impact on land uses or zoning in the study area. No displacement of schools or similar facilities would occur. None of the three alternatives would affect operations, maintenance requirements, integrity of foundations or corridors for power transmission lines presently in the channel bottom near the Dodge Street Bridge.

5.4.2 No Action (Future without Project)

Under the no action alternative, the river channel and the land uses along the channel would likely undergo a gradual transition to higher-density residential development, particularly north of the Rillito. The area south of the Rillito River would probably see construction of a few more commercial centers, residential subdivisions, and apartment buildings. The land uses in the Finger Rock Wash area may be subject to future urban developments.

The most dramatic future land use change would result from the transportation project to realign River Road between Campbell and Dodge Boulevard and across the outwash

from Finger Rock Wash. Pima County may acquire parcels in the Finger Rock Wash area for this transportation improvement project. River Road would cross the Rillito River to join with Alvernon Way. This traffic improvement involves the construction of a new, and safer bridge. A Pima County regional park is planned for the river bend area. Rural residential properties in the bend area are being purchased for this future park, the visual character of which would pay tribute to the historic and cultural resources of the area. This transportation and park project would occur under the No Action Alternative, as well as the three restoration plans 2E, 2F, and 2H.

5.4.3 Minor Consequences of Restoration Alternatives

Implementation of any of the three restoration alternatives would not change in any way land use zoning foreseeable in the future in the absence of a restoration project. Full monetary compensation for lands on the overbank to be converted to terraces would render negligible that shift of 43 acres (at the most, Alternatives 2e and 2f) from agriculture to native habitat. No other substantive changes from current and future land uses would occur.

No impacts to land uses adjacent to the Rillito would be anticipated by implementation of any of the three restoration alternatives, comparing their foreseeable effects against the future conditions which would prevail in the absence of a project.

5.5 Aesthetic Resources

5.5.1 Equivalency of Changes Caused by Restoration Alternatives

Effects of all three alternatives, 2H, 2E, and 2F, would not differ materially from each other. Each would entail growth and reappearance of desirable native vegetation communities and greenery. Plantings along the river bottom would connect pockets formed where washes enter the Rillito and terraces built on the northern bank in the bend. Residents and recreationists in the study vicinity would experience an increase in vegetation communities, and subsequent wildlife, imparting a more extensive sense of nature. As part of the ambience desirable for an ecosystem restoration effort, these changes would constitute positive impacts. However, lacking a means to quantify such results, these beneficial changes in the aesthetic environment must be regarded as incidental. While aesthetic resources may be incidental to the project, they can influence the recreation resources by enhancing views and the overall experience, as well as providing shade.

The appreciation of aesthetic resources depends upon the degree and distance from which the project would be seen by viewers, viewer attitudes and activities, and the extent to which the project is consistent with aesthetic goals and objectives. While recreationalists using the river park will benefit from the incidental increase in aesthetic resources, automobile drivers and passengers are likely to be less affected as they travel across the study area via bridges.

5.5.2 No Action (Future without Project)

Under the no action alternative, the future conditions for aesthetic resources would gradually worsen over time. No pronounced growth of trees and desirable vegetation would be expected, yet residential and light commercial development would be expected to isolate more extensively the river from its surroundings. More trash and refuse would be deposited in the riverbed, degrading the aesthetic resources with clutter. Vegetation communities, particularly those with a tree component, would decline in future years and this would further degrade the aesthetic resources.

5.5.3 Minor Consequences of Restoration Alternatives

Future effects on aesthetic resources under implementation of a project are equivalent for the three alternatives, 2H, 2E, and 2F. Implementation of the alternatives would soon lead to more pleasing views of riparian vegetation in the direction of terraces, washes,

and the river bottom itself, where sense of a circumscribed flood conveyance channel would be replaced by groves of riparian trees, adjacent mesquite bosques, and vegetated upland. Implementation of the alternatives would result in restored biological and hydrological resources and a subsequent increase in desirable riparian vegetation communities and correspondingly improved aesthetic resources.

Under the no action alternative, the aesthetic resources are expected to continue to decline. Despite the anticipated increase in aesthetic resources under the alternatives these benefits cannot be measured, although the net change would be deemed beneficial, it must also be considered incidental. Therefore, there would be no difference between the restoration alternatives and the future without project, hence no impact would be expected.

5.6 Recreation Resources

5.6.1 Equivalency of Changes Caused by Restoration Alternatives

Short-term and temporary adverse impacts to recreation resources would occur during the construction phase of this project, when the terraces, gabions, and basins are being installed necessitating temporary closures and detours from existing trails. Advanced notification of trail access and detours would be posted and construction would be phased and planned to minimize this inconvenience. This would minimize any short-term temporary adverse impacts to recreation resources.

In the river channel, where gabions would be installed, the newly planted vegetation communities would have a greater chance of becoming established and surviving if disturbance to them is limited. As a temporary measure it may be necessary to install signs that deter recreationists from disturbing this vegetation during the early stages of restoration, even though many recreationists tend to avoid vegetated areas in the river bottom already.

Each one of the three restoration alternatives would yield long-term beneficial impacts to recreation resources. First, the improvement in the visual quality of the riparian communities would greatly enhance the recreationist's experience. Second, bird-watching enthusiasts would be drawn more often to more locales within and along the Rillito because the resulting high-quality vegetation communities would attract more avian species, as well as other wildlife, to the area. Improved hydrologic functions, as well as water harvesting, would also promote more diverse fauna (vertebrates and invertebrates included) and thus fostering more recreational opportunities to study and enjoy nature. So, with the implementation of any restoration alternative there would be beneficial changes to recreation resources. The trails would be re-aligned to direct recreationists away from sensitive habitat areas, especially where one or two terraces would be constructed, to minimize disturbance of wildlife by people.

All restoration alternatives include construction of a pedestrian and bicycle bridge (and possibly useful to equestrians whose mounts do not spook from heights) where it turns north in the bend, ramps and paved trails, along with a south bank turnaround area for maintenance vehicles, both for maintenance purposes. The sponsor would build an additional bridge spanning the river at Columbus Boulevard. Facilities that will be constructed for recreation purposes include 10 additional parking spaces at Craycroft, trails, and trail linkages. These measures would improve the connectivity of the trail system and facilitate better access between the riverbank trails and the river channel.

Under Alternatives 2E, 2F, and 2H, these improvements to recreation features would increase recreationists' access and ease of park use.

5.6.2 No Action

Steady population increases in the northern part of Tucson, even if slow, in the future will elicit either additional parks or physical rearrangement and expansion of those already present. Within the study area the Catalina foothills would invite some infill of new houses, while the area south of the Rillito River would probably see somewhat greater infill of medium- to high-density residential development mixed with more commercial enterprises. This infill would add to the population base that uses the study area for recreation, as would the growing population within the entire Tucson metropolitan area. The design and development of these future parks would transform the river parks, now largely independent from each other into a basin-wide, interconnected system by improving recreational access (at least walking, bicycling, horse back) between them. There already exist planned improvements related to recreation activities, such as pedestrian bridges across washes and across the Rillito itself, riverside trails, vegetation plantings, and facilities intended to enhance the recreation opportunities and access. Except for one portion of the Rillito's banks, established and maintained paths already exist along both sides of the river, approximately 9.1 miles in total length and inside the area addressed by plans for ecosystem restoration. That gap spans approximately 3200 feet on the left-hand bank (facing downstream) between Prince and North Country Club Roads where insufficient room for any formal trail exists on the river side of developed lands, so none has been built. The path on the right-hand bank mostly serves a pedestrian and bicycling clientele, while equestrians mostly use the path on the left-hand bank north; although not always immediately at the banks.

The most extensive physical change affecting future recreation resources of the study area would convert about 60 acres of land in the river bend area from its current agricultural and horse-property usage to a regional park with a dedicated emphasis on the historical qualities of early settlement and agrarian commerce in the Binghampton community. As planned, the park would straddle a realigned and widened River Road, provide numerous recreational benefits, and draw people to the river corridor where connecting trails already exist on both banks along nearly all this portion of the river, as well as to the park itself. A pedestrian bridge comparable to that already present downstream (where North Country Club Road ends just south of the Rillito) is under consideration for the river bend area.

5.6.3 Difference Between Alternatives and Future Without Project: No Impact

The future without project would not focus on restoration of the riparian ecosystem planned for new parks adjacent to the Rillito. This captures the essence of the distinguishing factor between the no action alternative and the three restoration plans. Higher-quality trail surfaces would be installed by each alternative, but no additional length of trails would be created. Connectivity between segments of the river bank would rise very substantially with addition of a second bridge linking the north and south banks of the Rillito at the bend and a third bridge upstream at Columbus. Judged qualitatively, the three restoration alternatives would cause substantive improvement of recreational aspects of the Rillito's banks and adjacent parks. As no objective means exists for weighing beneficial changes to recreational resources attributable to more extensive riparian habitat, the resultant difference between the future without project and any one of the three restoration alternatives would best be summarized as incidental, although beneficial. This can only be reckoned as incident, despite being desirable. Therefore, the restoration alternatives would cause no adverse recreational impact.

5.7 Air Quality

5.7.1 Equivalency of Changes Caused by Restoration Alternatives

Effects of the three alternatives, 2H, 2E, and 2F, would be equivalent. A decision to implement any one of these three restoration alternatives would cause a temporary and short-term increase in fugitive dust and air borne particulate matter during construction of the project. However, with the implementation of best management practices (BMPs), the increase in particulate matter would not exceed the *de minimus* threshold. During the construction phase there also would be an increase in vehicle emissions due to construction vehicles working on the project. This would result in a small increase in emissions of CO, PM_{10}, and ozone that would be below the *de minimus* threshold of significance, so there would be no significant impacts. Once the construction phase is complete, the three project alternatives, 2H, 2E, and 2F, would not promote additional vehicular use beyond that expected under the no action alternative. Hence, implementation of one of the three projects would not affect future air quality.

Based on a conformity applicability analysis, the estimations of maximum emissions associated with construction of all aspects of each of the three restoration alternatives would be negligible. The estimations assume known operational characteristics of earth moving machinery kept in good repair, hauling assorted materials off-site over paved surfaces at standard speeds, appropriate use of watering trucks to suppress fugitive dust emissions, and operation of machinery for 30 working days and in use 8 hours per day. Numeric calculations predict total emissions (measured in quantities of tons/year, Table 5.7-1) very much below the existing concentrations.

TABLE 5.7-1
ESTIMATED TOTAL EMISSIONS WITH IMPLEMENTATION OF EITHER ONE OF THE THREE RESTORATION ALTERNATIVES

Condition	Emissions				
	VOCs	NO_x	CO[1]	SO_x[1]	PM_{10}
Proposed Action	14	192	21	19	14

5.7.2 No Action (Future without Project)

Under the no action alternative, there would be no project, so no short-term emissions associated with project construction would not occur.

Under the no action alternative, the future conditions for air quality would likely continue to deteriorate slowly as concentrations of some criteria pollutants rise with increased vehicular transportation engendered by urban expansion. Levels of nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) are relatively low and have had no significant changes in the previous 10 years and are likely to remain the same for the next 50 years. Particulate matter (PM_{10}) trends have remained relatively stable, with annual average levels well below the federal standards. Lead monitoring was discontinued in 1997, due to decreasing levels of lead in gasoline and lack of a stationary point source for lead pollutants, and there are no plans to monitor lead in the future. Levels of CO are likely to increase in the future due to the expected population increase and subsequent motor vehicle use. The increase in CO may lead to an increase in ozone levels since the major source of O_3 precursors is motor vehicle emissions. While O_3 levels have remained relatively steady for the past five years, the levels are slowly approaching the NAAQS.

5.7.3 Minor Consequences of Restoration Alternatives

While implementation of one of the three project alternatives, 2H, 2E, and 2F, may temporarily increase the amount of particulate matter and carbon dioxide in the project area, these levels would not exceed the *de minimus* threshold, so this would not be a significant impact. Implementation would have no effect on future air quality trends, which are trends of stability. Likewise, the no action alternative (future without project) would have no effect on the future air quality stability trend. Therefore, there is no difference of the effect on air quality between implementation of the alternatives, or the no action alternative.

5.8 Noise

5.8.1 Equivalency of Changes Caused by Restoration Alternatives

Effects of all three alternatives are equivalent. Each would entail limited use of mechanized equipment to remove existing soil cement, clear and grub equivalent acreage, haul construction debris off-site, and shape terraces in the bend area. Machinery could be in use as much as three weeks, during which time there would be a temporary and localized increase in noise levels. That local would shift steadily completion of ground preparation in one spot and movement to the next. Construction of a project would require the use of heavy equipment during construction that is intrinsically noisy. The noise emissions will be most heavily concentrated in the immediate vicinity of the areas to be graded and other areas requiring heavy construction equipment. The noise exposure at the nearest sensitive receptor will vary primarily with the level of activity of the equipment in use and its proximity to those receptors. The increase in sound level would be greater for those residents closer to construction. The effects of the construction noise would attenuate with distance and would be approximately 70 dB(A) approximately 500 feet from the construction activity. Construction noise sources are not strictly relative to a 24-hour community noise standard because they occur only during selected times and the source strength varies sharply with time. To abate the potential nuisance from construction noise, local noise ordinances typically limit the allowable time periods for non-emergency construction activities within residential areas. The expected temporary increase in noise levels would be minimized by curtailing construction activities to normal weekday work hours and muffling all engine noises appropriately. Therefore, any short-term temporary noise impacts would be mitigated to a level of no significance. Temporary increases of sound intensity would revert to background levels as soon as construction ceases.

Where the alternatives each yield galleries of cottonwoods and willows, the vegetation itself would muffle some urban sounds that would otherwise be reflected off hard plane surfaces. Additionally, wind blowing through leaves and such bird songs as might be audible would convey a stronger sense of sounds of nature. The changes of sound level would be localized to small regions of the river bottom. They would not be perceived at any real distance away from the riverbed, and hence should be counted upon to diminish background sound levels in any regional sense. As part of the ambience desirable for an ecosystem restoration effort, those changes from the future without project constitute positive impacts. Lacking a means to quantify such results, this beneficial change in the acoustic environment near stands of trees and vegetation must be regarded as incidental.

5.8.2 No Action (Future without Project)

The future without project would not require use of mechanized equipment. No temporary increases of sound level would occur in the absence of construction activities. Similarly, no pronounced growth of trees would be expected. Therefore no localized areas within the river bottom and mouths of washes would be expected to become quieter.

5.8.3 Minor Consequences of Restoration Alternatives

As trees attain their proper mature growth form, small areas in the Rillito would become quieter than would be expected if no restoration alternative were implemented. The net change would be deemed beneficial. The magnitude cannot be measured in any objective way, however, although a positive impact would be the result. It would be intentional by overall project design, but incidental in nature. Therefore, no adverse or beneficial impacts would be expected with a restoration project.

5.9 Cultural Resources

5.9.1 Impact Significance Criteria

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.

5.9.2 Resolution of Adverse Effects

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, local governments, 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).

Preliminary project designs involving water conveyance indicate potential adverse effects to the historic setting associated with the historic town of Binghampton (AZ BB:9:238 ASM), which is eligible for listing in the National Register of Historic Places (NRHP). Proposed planting along the riverbank at Binghampton may not be an adverse effect since trees were planted historically in the same context. Once more detailed plans are available, and after consideration of buried prehistoric resources along the bank of the river, a determination of effect will be made in consultation with tribes and Pima County.

The remainder of known resources are potentially avoidable by the project. The floodplain may contain buried resources however. If additional sites cannot be avoided, they will be evaluated regarding eligibility for the National Register. All NRHP sites that will be impacted by project constructed will be mitigated. See environmental commitments and compliance sections.

5.9.3 Environmental Commitments

Qualified archeologists will perform a survey of previously unsurveyed areas within the project's area of potential effects, including Finger Rock Wash. Subsurface exploration to determine the presence/absence of buried cultural deposits may also be necessary.

If cultural resources cannot be avoided, they will be evaluated regarding eligibility for listing in the National Register of Historic Places.

Identification, evaluation, and mitigation studies will be coordinated with Pima County and intrested Native American Indian Tribes.

Archeologists from Pima County and the Corps will participate in the design of water conveyance features across the landform associated with the historic town of Binghampton in an effort to minimize adverse effects.

Since it is likely that National Register listed or eligible properties will be adversely affected by the project (i.e., Binghampton), a Memorandum of Agreement will be negotiated with the Arizona State Historic Preservation Officer (SHPO), Pima County, and interested Native American Indian tribes. An archeological site treatment plan will be developed in consultation with the SHPO, Pima County and interested Native American Indian tribes.

In accordance with 36 CFR 800, regulations implementing Section 106 of the National Historic Preservation Act, a records search has been performed. Corps identification and

evaluation studies will be coordinated with Pima County and interested Native American Indian tribes. The Corps' determinations of eligibility and effect will be coordinated with the Arizona SHPO. Proposed project features that currently involve AZ BB:9:238 (ASM) (Binghampton) indicate that it is likely that National Register listed or eligible properties will be adversely affected by the project. Therefore, a Memorandum of Agreement (MOA) will be negotiated with the Arizona SHPO, Pima County, and interested Native American Indian tribes. An archeological site (historic properties) treatment plan will be developed in consultation with the SHPO, Pima County, and interested Native American Indian tribes as stipulated in the MOA. Until the field studies, consultation, and determinations of resource eligibility and project effect are completed, the project is not in compliance with the Act.

5.10 Hazardous and Toxic Waste

5.10.1 Equivalency of Changes Caused by Restoration Alternatives

It is highly unlikely that any serious hazardous or toxic waste contamination will be intersected by required ground preparation, based on an April 2003 Corps of Engineers follow-up screening of RECs identified in the original inventory. The three potential RECs noted on the north bank of the bend area warrant land-owner interview and a site walk-through to gather more information on potential asbestos containing materials or petroleum contaminants, either one of which would likely be present only in very small quantities, if any at all. No conditions of even likely potential concern regarding hazardous or toxic wastes have been identified in any other location where ground preparation would be required. This includes the alignment of the swale to carry water from the river to the mesquite thicket at Swan Road, the proposed outwashes for Finger Rock Wash, locations of gabions in the river bottom, and mouths of tributary washes. Neither movement of contaminated soils nor causal release of contaminants into groundwater resources would be foreseeable since no HTW sites would be disturbed. Monitoring by Corps Geotechnical staff during construction would facilitate characterization of any unexpected discoveries of possible hazardous or toxic substances.

5.10.2 No Action (Future without Project)

Under the no action alternative, the future without project would not require ground preparation. Since no ground preparation would occur, there is no chance that movement of contaminated soils would occur as a result of grading activities. Therefore, future conditions for hazardous and toxic waste under the no action alternative would remain much the same as they are now.

5.10.3 Minor Consequences of Restoration Alternatives

Potential effects on HTW concerns with implementation of a project are equivalent for all three alternatives. In turn, they do not differ from expectations of no action (future without project). There would be no casual change from existing conditions and therefore no discernible impact of any nature.

5.11 Socioeconomics

5.11.1 Equivalency of No Action (Future without Project) and Three Restoration Alternatives

Implementation of Alternatives 2E, 2F, or 2H would each result in reappearance of riparian communities native to the Rillito on elevational terraces along the north bank of the bend, along the outflow of Finger Rock Wash, and in the lowermost part of tributary washes. The City of Tucson already has plans for a regional park, to occupy much of the bend; the terraces and their trees would be visible from some of the residences left on the periphery of that park. Similarly, both the westward and the southern courses to carry runoff from Finger Rock Wash toward the Rillito would be restored as mesquite thickets, and these mesquite woodlands also would be visible from some residences and the community center.

While these new biological communities would, perhaps, impart a sense of rural serenity in a localized portion of the study area, they would not alter opportunities for employment, personal or commercial income, availability of housing, or the mix of residential, commercial, and recreational activities in the study area. The future without project may likely see steadily increased prosperity in the north portion of Tucson, but for reasons having to do with the economy of the entire region and not influenced in any measurable way by attributes of the alternatives themselves.

5.11.2 Minor Consequences of Restoration Alternatives

The perceived values of houses, apartments, commercial properties, and so forth will surely rise even in the absence of any plan to restore ecosystem features to the Rillito. Any direct, or indirect, effect of these Alternatives on indicators of economic change would be so small as to be indistinguishable and unmeasurable when viewed against the larger and variable economic forces influencing the region in the absence of any project.

No socioeconomic impact of significance would result from implementation of either one of these three restoration alternatives.

5.11.3 Difference between Alternatives and Future without Project

Future effects on socioeconomic resources under implementation of the three project alternatives, or the no action alternative are equivalent. They would not result in any significant impact. Therefore, there is no difference between the alternatives and the future without project regarding socioeconomic resources.

5.12 Utilities

5.12.1 Equivalency of Changes Caused by Restoration Alternatives

Effects of all three alternatives, 2H, 2E, and 2F, are equivalent. The existing power pole structures, currently located within the channel and upland areas, would not be affected. No removal or changes in the grade surrounding the bases would occur.

If the project alternatives were to be implemented, reclaimed water would be used to irrigate restored areas of vegetation communities including mesquite, cottonwood willow, and scrub/shrub communities on the terraces, in the basins, around the gabions in the river channel, and in the Finger Rock Wash channels. While the implementation of these measures would improve hydrologic functions and connections and increase water harvesting, it would still be necessary to use reclaimed water for irrigation particularly during the early years and periods of drought. The reclaimed water that would be used for this study would therefore not be available for future use. This effect on future reclaimed water use would not have any long-term significant impacts.

5.12.2 No Action (Future without Project)

The future without project would have no effect on utilities. Under the no action alternative, the utilities would remain much the same as they are now. Normal expansion of utilities would probably occur over time to accommodate the increasing demand for utility services, but that would occur independent of the no action alternative.

5.12.3 Minor Consequences of Restoration Alternatives

The main difference between implementation of the three project alternatives, and the no action alternative (future without project) is the use of reclaimed water irrigation. Under implementation of Alternatives 2H, 2E, and 2F, reclaimed water would be used to irrigate restored vegetation communities. However, under the future without project it is likely that irrigation with reclaimed water use would increase in the future, independent of implementation of project alternatives. The magnitude of change between reclaimed water use under the three project alternatives and the no action alternative is unable to be reasonably measured. Therefore, there would be no difference in reclaimed water use between the three project alternatives and the future without project conditions.

No impacts to any utilities or infrastructure would be anticipated by implementation of any of these alternatives, by comparison of foreseeable effects attributable to the alternatives against the future conditions which would prevail in the absence of a restoration project.

5.13 Transportation

5.13.1 Changes Attributable to Restoration Alternatives

Effects of all three alternatives, 2H, 2E, and 2F, are equivalent. Each would entail possible minor, short-term traffic disruption including bicycle traffic along the river park, only during the construction phase of the project. However, there would not be any significant impacts to transportation in the study area. The future expansion and realignment of River Road, including the new bridge extending and connecting to Alvernon, would occur.

Vehicular traffic would increase during construction, excess materials would be hauled off-site. The Speedway Landfill, approximately three miles distant from the site, has been identified as a potential repository for materials from the construction of terraces and basins. Short-term and temporary impacts would affect local traffic and transportation. These impacts would last approximately four months if Alternative 2H were implemented. Temporary impacts caused by Alternatives 2E and 2F would last approximately four and a half months. All such transportation impacts would occur during normal working hours of weekdays. These estimates assume use of trucks with 20 cubic yard hauling capacity, operating eight hours per working day and completing 25 round trips per hour.

With the implementation of the three project alternatives, there would be some benefits such as increased access to the river park area with the additional parking, however, this benefit would be incidental and would have no effect on the overall traffic in the park. Implementation of other recreation measures, such as expanded trails, maintenance access ramps and pedestrian bridges, would improve the circulation of pedestrian, bicycle, and equestrian traffic within the river park. While these measures will improve circulation within the river part, this will not result in a measurable significant effect to traffic resources. While the measures will have a beneficial impact, they will not have a measurable effect on traffic resources, so these benefits would be incidental.

5.13.2 No Action Alternative (Future without Project)

Existing conditions in the future for the transportation conditions would be the same as they are now, with a gradual increase in congestion.

Two proposed traffic improvement projects located within the study area include the proposed widening and extension of River Road to Alvernon Way and the extension of Alvernon Way from the intersection at Fort Lowell Road north and west across the Rillito River to connect with River Road. The project consists of widening and realigning River

Road from east of Campbell Avenue to the extension of Alvernon Way, east of Dodge Boulevard. The existing Dodge Boulevard bridge would remain intact and may be used as a vehicular bridge or as a pedestrian and bicycle bridge.

5.13.3 Short-term Impacts, Minor Consequences of Restoration Alternatives in the Long Term

During construction, trucks hauling materials off-site would operate over paved roads in the study area, and beyond it to the west, and thereby promote traffic congestion. This constitutes a short-term impact, which would not occur in the absence of a restoration project. This temporary impact would occur within the project area. When construction ends, traffic volumes in the region and in the project area would revert to existing conditions. Therefore, this impact would have a finite duration then cease altogether and would not be deemed significant.

When construction ends after completion of any one of the three project alternatives, there would no substantive change of traffic volume or other transportation services to come or go from the project area. Within the restoration project the separation of routes, one for vehicular maintenance and emergency access and the other for pedestrian, bicycle, and equestrian traffic would be deemed a permanent beneficial change. The level of that anticipated change cannot be measured in any objective way, so this beneficial impact would be counted as incidental only. An expected gradual increase in traffic congestion in the general region would have no causal connection to the restoration alternatives, but would be every bit as likely to accompany the future without project. Therefore, there would be no difference between the project alternatives and future without project on transportation, hence no persistent impact.

5.14 Safety

5.14.1 Equivalency of Changes Caused by Restoration Alternatives

Effects of all three alternatives, 2H, 2E, and 2F, are equivalent. Under the implementation of the alternatives, there would be no significant impacts to safety in the study area. Removal of soil cement and installation of terraces in the bend area would function to restore the hydrologic connection and provide an area for high flows to spread out across during periods of high flow, mimicking historic conditions. Finger Rock Wash high and low flow channels would direct high rain flows into the river channel which would help to minimize sheet flow in the bend area. Implementation of the gabions would not increase the flooding in the river channels since they would be designed to dislodge during high flow (approximate 25-year high flows). Implementation of the basins would not increase the flooding in the river channel nor create a vector problem since the basins would have a modified weir, which would allow water to seep out and drain within 24 hours.

Under implementation of the three project alternatives, an incidental safety benefit would result from the installation of access ramps for maintenance. These ramps would facilitate an easy exit out of the river channel in the event of an emergency flash flood.

5.14.2 No Action (Future without Project)

Under the no action alternative, safety threats associated with flood hazards would continue to exist, particularly along the north side of the Rillito River by Finger Rock Wash. Future flood events particularly the 125-year flood event, may cause flooding in this area and subsequent health hazards. The waters from the 100-year flood are anticipated to be contained within the soil cement banks of the Rillito.

5.14.3 Difference between Alternatives and Future without Project

Future flood events are likely to occur with or without implementation of the three project alternatives, as well as under the future without project. While implementation of the three project alternatives, 2H, 2E, and 2F, would not increase the likelihood of flooding in the study area, it would not reduce flooding concerns either. These are the same conditions that will occur under the future without project scenario. Flooding concerns and safety issues will continue to exist in the future under the project alternatives as well as the no action alternative. Therefore, there is no difference in safety between the project alternatives and the future with no project.

Chapter 6.0

Compliance with Applicable Federal and Arizona Statutes

The following environmental laws, Executive Orders, and relevant policies have been considered during the preparation of this Environmental Impact Statement (Table 6-1).

The Arizona Department of Environmental Quality (ADEQ), an agency of the state responsible for water quality, was contacted to coordinate the process in accordance with ER1105-2-100. A letter in response from ADEQ was received March 23, 2004, which states the proposed restoration project should comply with State surface water quality standards and that it should not have a negative impact upon the physical, chemical, or biological integrity of the Rillito River. It further states that the State of Arizona concurs with the 404(r) exemption for State 401 Water Quality Certification (see Attachment A).

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
National Environmental Policy Act, as amended (42 USC 4321 et seq.); NEPA.	Council on Environmental Quality	United States Congress mandated a national policy to ensure all agencies of the Federal Government consider fully the potential environmental consequences of all their proposed actions.	EIS conforms in form and substance
Endangered Species Act of 1973 (Public Law 93-205; 16 U.S.C. 1531 et seq.).	U.S. Fish and Wildlife Service	§7 of the ESA directs all agencies of the Federal Government to ensure their proposed actions do not jeopardize the continued existence of endangered or threatened species, or destroy or adversely modify habitat critical to the life cycle needs of such species.	No federally protected species occur within project area; project conforms with ESA.
National Historic Preservation Act of 1966 (36 CFR 800); NHPA.	Advisory Council on Historic Preservation	§106 directs all agencies of the Federal Government to evaluate potential effects on historic properties of federal or federally assisted undertakings. Any undertaking that may adversely affect properties listed in, or eligible for listing in the National Register of Historical Places must be offered for consideration by the Advisory Council of Historic Preservation.	Until the field studies, consultation, and determinations of resource eligibility and project effects are completed, the project is not in compliance with the Act.
Clean Air Act of 1990 (42 U.S.C. 7401 et seq.).	Environmental Protection Agency, Arizona Department of Environmental Quality	Mandates the prevention and control of air pollution from stationary and mobile sources. Requires the establishment of national ambient air quality standards to regulate primary and secondary concentrations for six priority air pollutants; new source performance standards to provide ceiling emission standards for certain new industrial sources; and national emission standards for hazardous air pollutants to control pollutants not covered under the national ambient air quality standards, which may increase mortality rates of cause serious irreversible illness.	Emissions of criteria pollutants during construction would be at negligible levels. The project would comply with the Clean Air Act.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
Clean Water Act of 1972 (Public Law 92-500, as amended; 33 U.S.C. 1251 et seq.).	U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, Arizona Department of Environmental Quality	The Clean Water Act (CWA), a 1977 amendment to the Federal Water Pollution Control Act of 1972, is the primary federal law that protects the nation's waters, including lakes, rivers, aquifers, and coastal areas. Its main objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Relevant sections of the CWA include:	
		Section 304: mandates the EPA will publish water quality criteria guidance to protect aquatic life.	
		Section 401: requires federal agencies to obtain state water quality certification for any federal project or permitted project that may affect water quality.	The project would comply with State surface water quality standards. The State of Arizona concurs with the 404(r) exemption for State 401 Water Quality Certification (see Attachment A).
		Section 402: establishes conditions and permitting for point-source discharges of pollutants under the National Pollution Discharge Elimination System (NPDES). Pursuant to NPDES requirements, a General Construction Activity Storm Water Permit is required for project construction, and a standard NPDES permit is required for the direct discharges of groundwater into the wash. A Storm Water Pollution Prevention Plan (SWPPP) must be prepared in order to obtain the NPDES permit. The SWPPP outlines Best Management Practices to minimize water contamination during construction.	An evaluation of potential effects by each restoration alternative on water quality has been included as the 404(b)(1) analysis, included as Attachment A, which accompanies this EIS. The project would conform to this provision of the Clean Water Act.
		Section 404(b): prohibits the discharge of dredged or fill materials into the waters of the United States, including wetlands, except as permitted under separate regulations by the U.S. Army Corps of Engineers and the Environmental Protection Agency.	A grading plan would be prepared prior to construction. Pending acceptance of that plan, the project would not be in compliance with this provision of the Clean Water Act.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
Farmland Protection Policy Act (7 U.S.C. 4201 et seq.).	Natural Resource Conservation Service	Requires federal agencies to identify prime and unique farmland. Provides that federal agencies take into account adverse effects of federal programs on the preservation of farmland and consider alternative actions to reduce these effects.	The restoration alternatives would not affect prime or unique farmlands. The project would comply with this Act.
Fish and Wildlife Coordination Act (Public Law 85-624; 16 U.S.C. 661 et seq.).	U.S. Fish and Wildlife Service	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.	A Planning Aid letter and Coordination Act Report have been received. The final letters indicate compliance with this Act.
Migratory Bird Conservation Act of 1918 (Public Law 65-186; 16 U.S.C. 703 et seq.).	U.S. Fish and Wildlife Service	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.	The Restoration Alternatives would not necessitate destruction of vegetation in use for nesting or fledging. The project would be in compliance.
Migratory Bird Treaty Act of 1918 (1989 Amendments).	U.S. Fish and Wildlife Service	The Migratory Bird Treaty Act (MBTA) prohibits the taking or harming of any migratory bird, its eggs, nests, or young without an appropriate federal permit. The take of all migratory birds is governed by the MBTA's regulation of taking migratory birds for educational, scientific, and recreational purposes and requiring harvest to be limited to levels that prevent over-utilization. Section 704 of the MBTA states that the Secretary of the Interior is authorized and directed to determine if, and by what means, the take of migratory birds should be allowed and to adopt suitable regulations permitting and governing take.	All construction would be accomplished outside the general spring and fall migratory season. The project would be in compliance with all provisions of this treaty.
Wild and Scenic Rivers Act (Public Law 90-542; 16 U.S.C. 1274).	U.S. Park Service	Requires identification and protection of any river or stream that qualifies under the act.	The Rillito River does not qualify for this designation. The project would be in compliance.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).	U.S. Environmental Protection Agency	Congress passed CERCLA, also known as "Superfund," in response to a growing national concern about the release of hazardous substances from abandoned waste sites. CERCLA gives the federal government broad authority to regulate hazardous substances, to respond to hazardous substance emergencies, and to develop long-term solutions for the nation's most serious hazardous waste problems. CERCLA requires the parties responsible for the contamination to conduct or pay for the cleanup. Under Section 120 of CERCLA, each department, agency, and instrumentality of the United States is subject to, and must comply with, CERCLA in the same manner as any nongovernmental entity.	No locations of hazardous materials, as described by CERCLA, occur within the project area. While some hazardous materials exist in the surrounding area, none exist in the area affected by the project. The project would be in compliance with this legislation.
EO 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.	Department of the Army	Requires federal agencies to assess potential impacts of their proposed actions on minority and low-income populations as part of their compliance with NEPA. Agencies are encouraged to include demographic information related to race and income in their analysis of the environmental and economic effects associated with their actions.	The project would be implemented in one of the more well-to-do portions of Tucson. The habitat restored would be accessible to persons of all race and creed. The project would be in compliance with this Executive Order.
EO 11988 Floodplain Management.	Department of the Army	Specifies "Agencies shall also encourage and provide appropriate guidance to applicants to evaluate the effects of their proposals in floodplains before submitting applications." This order includes wetlands that are within the 100-year floodplain and especially discourages filling.	Each Restoration Alternative would restore, in comparatively small extent, hydrologic processes on a portion of the floodplain at the Bend. The project would augment natural floodplain processes, rather than suppress them further, and therefore is in compliance with this Executive Order.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
EO 11990 Protection of Wetlands.	Department of the Army and U.S. Environmental Protection Agency	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 that affect land use.	Such minimal wetlands as now exist would be augmented similarly. Additionally, gabions in the river bottom would foster the reappearance of cienegas, thereby adding to the nation's inventory of wetlands in this arid region. The project would be in compliance with this executive Order.
EO 13112 Invasive Species.	Department of the Army	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.	Each Restoration Alternative would require periodic removal of giant reed and deciduous saltcedar. Both are acknowledged invasive weed species. Therefore, the project would comply with this Executive Order.
Procedures for Nongame Wildlife and. Endangered Species Re-establishment Projects in Arizona, Arizona Game and Fish Department, 1987.	Arizona Game and Fish Department	Directs AGFD to pursue an active program of reestablishment of threatened native wildlife in Arizona, where appropriate. Provides a "12-step" procedure for determining the feasibility and appropriateness of proposed native species projects. Where practical, proposed activities should be conducted within the AGFD guidelines.	The project would not preclude re-establishment of native species. Therefore, the project would be in compliance with this regulation.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
Arizona Department of Agriculture Native Plant Protection Law.	Arizona Department of Agriculture	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 before 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).	No species protected by this Arizona statute occurs within the project area. None would be disturbed. Therefore the project would comply with this law.
Arizona Groundwater Management Act.	Arizona Department of Environmental Quality	To address the over-drafting of Arizona's groundwater supplies, the Arizona State Legislature passed the Groundwater Management Act in 1980. The Groundwater Management Act specified areas that are depleting groundwater resources to be designated as Active Management Areas, or AMAs.	The project would not rely directly on water subsurface extraction to provide irrigation needs. Neither would consume water supplies already committed to another use, and thereby indirectly promote additional withdrawals to meet net greater demands. The project would be in compliance

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
State Implementation Plan (SIP).	Arizona Department of Environmental Quality	The State Implementation Plan (SIP) is the cumulative record of all air pollution strategies, non-attainment area plans (NAPs), statutes, rules, and ordinances implemented under Title I of the Clean Air Act by governmental agencies within Arizona. Revisions to Arizona's SIP must be submitted to the EPA by the director of the Arizona Department of Environmental Quality on behalf of the governor. Once approved by EPA as published in the Federal Register, the provisions contained in the SIP revision become enforceable by the federal government as well as by the appropriate governmental entities of Arizona. The following rules that have been adopted by ADEQ that may be applicable to the restoration project are:	
		Arizona Administrative Code Rule Title 18, Chapter 2, Title 606 (R18-2-606), Material Handling. No person shall cause, suffer, allow or permit crushing, screening, handling, transporting or conveying of materials or other operations likely to result in significant amounts of airborne dust without taking reasonable precautions, such as the use of spray bars, wetting agents, dust suppressants, covering the load, and hoods to prevent excessive amounts of particulate matter from becoming airborne.	All site preparation, excavation of overbank materials, and hauling of those materials off-site would be accomplished with full implementation of best management practices, including liberal use of spray trucks to dampen surfaces and minimize fugitive dust. The project would be in compliance with this provision of the SIP.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
		R18-2-802, Off-road Machinery. (A) No person shall cause, allow or permit to be emitted into the atmosphere from any off-road machinery, smoke for any period greater than 10 consecutive seconds, the opacity of which exceeds 40 percent. Visible emissions when starting cold equipment shall be exempt from this requirement for the first 10 minutes. (B) Off-road machinery shall include trucks, graders, scrapers, rollers, locomotives and other construction and mining machinery not normally driven on a completed public roadway.	All earth moving machinery would be kept in peak operating condition. Exhausts from these diesel-powered machines would be monitored to assure achievement of these emission standards. The project would be in compliance with this provision of the SIP.
		R18-2-607, Storage Piles. (A) No person shall cause, suffer, allow, or permit organic or inorganic dust producing material to be stacked, piled, or otherwise stored without taking reasonable precautions such as chemical stabilization, wetting, or covering to prevent excessive amounts of particulate matter from becoming airborne. (B) Stacking and reclaiming machinery utilized at storage piles shall be operated at all times with a minimum fall of material and in such manner, or with the use of spray bars and wetting agents, as to prevent excessive amounts of particulate matter from becoming airborne.	Implementation of best management practices would achieve these standards. The project would be in compliance with this provision of the SIP
Pima County Comprehensive Plan, Land Use Element.	Pima County, Arizona	The plan provides a long-range guide to growth and development in the unincorporated eastern part of the county.	All aspects of the proposal to restore ecosystem processes along the Rillito are consistent with this Plan. The project would be in compliance.

TABLE 6-1
CONFORMITY WITH ENVIRONMENTAL STATUTES AND REGULATIONS BY THREE ALTERNATIVES PROPOSED FOR ECOSYSTEM RESTORATION AND ANALYZED IN THIS EIS FOR EL RIO ANTIGUO FEASIBILITY STUDY
(continued)

Law or Regulation	Oversight Agency	Legislative Purpose	Declaration
Sonoran Desert Conservation Plan.	Pima County	Plan has a goal of combining short-term actions to protect and enhance the natural environment with long-range planning.	The project would deliberately restore significant elements of the riverine ecosystem native to the Sonoran Desert. The project would be in compliance with this long range goal.

Chapter 7.0
Cumulative Impact Analysis

7.1 Topics Without Cumulative Effects

A decision to implement any one of the three restoration alternatives, 2e, 2f, or 2h, would cause very minor or altogether negligible effects to 12 of the 14 aspects of the human environment of the Rillito River (Sections 5.1 through 5.14). Regarding these aspects (Table 7.1-1), future conditions projected specifically in the absence of a restoration project and those attributable to construction and operation of an ecosystem restoration project are expected to be indistinguishable.

TABLE 7.1-1
TOPICS OF THE HUMAN ENVIRONMENT FOUND TO LACK ADVERSE CAUSAL IMPACTS, BY ANALYSES PRESENTED IN CHAPTER 5

Topic	Text Reference	Remarks and Summation
Topography and Geology	§ 5.1	Neither temporary nor permanent impacts would result.
Land Use	§ 5.4	Neither temporary nor permanent impacts would result.
Aesthetic Resources	§ 5.5	Beneficial improvements of local and broader views of riparian communities would occur. However, their incidental character renders them nonsignificant.
Recreational Resources	§ 5.6	Substantive and desirable improvement of recreational aspects of the Rillito's banks and adjacent parks would occur. These would be incidental to the restoration alternatives and, therefore nonsignificant.
Air Quality	§ 5.7	Temporary emissions of criteria pollutants would be expected during construction and hauling of materials offsite. All emissions would cease after construction. Therefore, only nonsignificant temporary impacts would occur.

TABLE 7.1-1
TOPICS OF THE HUMAN ENVIRONMENT FOUND TO LACK ADVERSE CAUSAL IMPACTS, BY ANALYSES PRESENTED IN CHAPTER 5
(continued)

Topic	Text Reference	Remarks and Summation
Noise	§ 5.8	Temporary noise levels would rise during construction, but be mitigated by adherence to local noise ordinances. Lower noise levels amid riparian communities, especially as they mature, would constitute a beneficial, but incidental improvement. No permanent impact would result.
Cultural Resources	§ 5.9	Proper treatment of resources discovered during construction would constitute full mitigation. Restoration of riparian conditions in the Bend would resemble historical setting. No permanent adverse impacts would result.
Hazardous and Toxic Wastes	§ 5.10	Neither temporary nor permanent impacts would result.
Socioeconomics	§ 5.11	Neither temporary nor permanent impacts would result.
Utilities	§ 5.12	Neither temporary nor permanent impacts would result.
Transportation	§ 5.13	Temporary impacts of short duration would occur during construction. These would be nonsignificant. No permanent impacts would result.
Safety	§ 5.14	Neither temporary nor permanent impacts would result.

No significant impacts, either adverse or beneficial in nature, would result through any of these twelve resource areas. Since no direct or indirect impacts would be forthcoming with any of the three ecosystem restoration alternatives, these twelve aspects of the human environment also would not contribute to cumulative impacts in any regional sense. By the same token, projects underway or being planned would not induce cumulative direct or indirect impacts on these topics within the project area. Therefore, these warrant no further discussion in the context of cumulative impacts.

7.2 Water Resources

Implementation of the proposed action, together with other cumulative projects, is expected to improve hydrology and water resources in the area. Therefore, a beneficial cumulative effect to water resources is anticipated. For the proposed action, the construction and implementation of gabions, basins, terraces and channels are expected to improve water quality, absorption and infiltration, desirable sedimentation, and stream flow characteristics. Other cumulative projects in the area, including the long-term planned decrease in groundwater pumping within the Tucson basin, will likely have the same beneficial impacts to hydrology and water resources. The proposed action is not expected to have adverse effects on hydrology issues such as alteration of watercourses or increase in flooding potential. Therefore, the proposed action is expected to contribute to a cumulative beneficial effect to hydrology in the area.

Regarding cumulative effects to reclaimed water, the proposed action will use reclaimed water for irrigation of restored vegetation communities. In addition, other restoration projects in the Tucson area may also use reclaimed water for irrigation purposes. Currently, there is little demand for the reclaimed water in the Tucson area; however, in the future the demand for reclaimed water is expected to increase. This increase in demand for reclaimed water would occur independent of implementation of the proposed action and other cumulative projects. The amount of water projected for use by the proposed action is small compared with the anticipated future demand for reclaimed water. Currently, the majority of reclaimed water in the Tucson area is discharged into the Santa Cruz River, not distributed by the existing reclaimed infrastructure. Therefore, the proposed action is not expected to have cumulative impacts on reclaimed water use.

7.3 Biological Resources

Implementation of the proposed action, together with other cumulative projects, is expected to have a beneficial effect on the biological resources in the area. For the proposed action, improvement of native riparian vegetation communities will result from the improvement in hydrologic function, increased soil moisture, and large-scale revegetation efforts. Improved vegetation communities will have a direct and positive impact on wildlife by providing improved, diverse habitat. Therefore, a beneficial cumulative effect to biological resources is anticipated. Other conservation efforts in the area will likely have the same beneficial impacts to biological resources. Specific beneficial effects include significant increases in vegetative cover, increase in biodiversity, increase in breeding and foraging habitat niches, increase in connectivity along the watercourse and between the project and the connecting watershed. The anticipated beneficial effect to biological resources is directly dependent on the beneficial effects to hydrology resources that will result from the proposed action and other cumulative projects in the area. The improvement of the hydrology and biology resources will result in improvements to aesthetic and recreation resources as well. In

general, the restoration efforts of the proposed action will contribute to the beneficial effects from other restoration projects in the Tucson area.

Restoration of the biological resources along the Rillito River will have a direct cumulative benefit to Pima County's conservation effort. In 1998, Pima County launched the Sonoran Desert Conservation Plan (SDCP) 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 also develop an interdependent relationship, where one enhances the other. The SDCP has 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. In 2001, Pima County updated its Comprehensive Plan to incorporate the Conservation Lands System that reflects the land use concepts, policies, and principles of conservation identified in the draft Preliminary SDCP. Restoration of the Rillito River is directly related to elements (4) Riparian Protection, Management, and Restoration, and (5-6) Habitat and Corridors Protection Elements, of the SDCP. Specifically, the Rillito provides the critical corridor link between the Rincon Mountains to the east, the Catalina Mountains to the North, and the Santa Cruz River to the west. The Rillito River provides the crucial path for wildlife movement that connects Pantano Wash, Tanque Verde Creek, the Santa Cruz River and numerous washes. While the content of the Rillito River will be significantly improved by this proposed restoration project, the context of the Rillito River plays and even greater role as a wildlife corridor that will have a significant beneficial cumulative effect on conservation in eastern Pima County.

7.4 Irretrievable or Irreversible Commitments of Resources

The proposed project alternatives described in this feasibility report and evaluated in this EIS would involve the commitment of resources. The use of the resources is discussed for each issue below.

7.4.1 Gabions

The construction of gabions would involve the use of rocks and small boulders in a metal cage that would function to retain the rocks in place. These cages would then be placed and secured in the river channel. The use of these rocks and small boulders would result in the use of this natural resource in a way that would be irretrievable. Rocks and small boulders are readily available, so this is not expected to be an adverse use of a resource.

7.4.2 Fossil Fuels

Fossil fuels would be used to power construction vehicles that are used to fabricate the project features. Fossil fuels are readily available at the present time but are finite in quantity. Construction of the proposed action would therefore result in the use of a resource that would be both irreversible and irretrievable.

7.4.3 Reclaimed Water

The proposed action would involve the commitment of reclaimed water to support restored and improved habitat and vegetation communities. Although water is a finite resource, the amount of available reclaimed water is expected to increase as the population of the Tucson basin increases over time. In this case, the water is being recycled, distributed and reused in a beneficial way.

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Chapter 9.0
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Chapter 10.0
Index

acre-feet	S-8, S-9, 48, 50, 172
Alamo Wash	1, 34, 68, 77, 135
alluvium or alluvial sediments	7, 8, 67, 72, 78, 81, 78, 92, 102, 163, 172
alternative 2e	S-5, 7, 50, 56, 163, 172, 181, 186, 187, 203
alternative 2f	S-5, 7, 56, 57, 59, 163, 172, 181, 185, 186, 187, 203
alternative 2h	S-6, S-9, 7, 54, 56, 57, 64, 163, 172, 181, 182, 184, 185, 186, 203
Alvernon Wash	S-6, 14, 18, 32, 38, 56, 67, 68, 77, 135, 182, 203
Arizona Game and Fish	S-4, 10, 11, 88, 107, 114, 211
Arizona State Historic Preservation Officer	10, 152, 153, 154, 197, 198, 199
Arizona walnut	S-8, 15, 48, 89
ash	S-8, 15, 19, 48, 89
average annualized functional capacity units, AAFCU	54, 57,72, 90, 91, 92, 180, 181
basins	Abstract, S-5, S-6, 3, 14, 17, 18, 21, 23, 25, 26, 27, 30, 31, 32, 34, 35, 36, 38, 39, 42, 43, 44, 46, 47, 48, 49, 50, 52, 53, 54, 56, 59, 64, 67, 75, 77, 130, 132, 161, 164, 167, 172, 174, 175, 176, 182, 186, 190, 202, 203, 205, 218
bend or riverbend	S-5, S-6, 3, 14, 17, 18, 21, 23 25, 26, 27, 30, 31, 32, 36, 38, 39, 50, 562, 56, 59, 64, 68, 74, 81, 106, 128, 135, 156, 157, 161, 163, 166, 167, 172, 175, 177, 182, 183, 186, 187, 188, 190, 191, 192, 195, 200, 201, 205, 217
beneficial impacts	Abstract, 176, 177, 178, 181, 182, 184, 185, 188, 189, 190, 192, 195, 196, 203, 204, 211, 216, 218, 219, 220
Binghampton	20, 27, 50, 149
Bosque Creek	34, 35
bridge(s)	S-6, S-9, 18, 21, 68, 84, 103, 105, 130, 144, 159, 165, 186, 187, 188, 190, 191, 192, 203, 204
buffer, buffer habitat	S-2, S-5, S-6, 4, 13, 26, 28, 49, 50, 52, 53, 54, 56, 59, 76, 91, 92, 181, 184, 185
Campbell Avenue	S-1, 1, 6, 14, 16, 17, 18, 19, 67, 68, 79, 86, 103, 105, 135, 139, 159, 186, 204

Central Arizona Project (CAP)	7, 25
channel; flood control, low flow, high flow, morphology, or river	Abstract, S-1, S-2, S-5, S-6, S-7, S-8, S-9, 11, 16, 17, 20, 232, 25, 26, 27, 28, 34, 35, 36, 38, 39, 41, 42, 43, 44, 46, 47, 48, 49, 52, 53, 54, 57, 59, 64, 67, 68, 74, 77, 78, 79, 81, 84, 91, 92, 102, 103, 130, 161, 174, 175, 176, 177, 179, 182, 183, 186, 189, 190, 202, 205, 218, 219
Christopher City Wash	32, 43, 44, 56, 68
cienega(s)	S-7, S-8, S-9, 8, 12, 14, 15, 20, 21, 23, 34, 49, 50, 115
Columbus Boulevard	1, 3, 18, 32, 67, 79, 88, 133, 135, 156, 161, 190, 192
corridor(s); biological, migratory, riparian, river, or wildlife	S-2, S-8, S-9, 4, 8, 13, 21, 28, 49, 57, 86, 91, 135, 141, 165, 166, 180, 181, 183, 184, 186, 191, 219
cost effective analysis (CEA)	S-3, 54, 57
cottonwood(s)	Abstract, S-5, S-6, S-7, S-8, 4, 8, 15, 16, 18, 19, 20, 21, 23, 27, 30, 31, 32, 34, 35, 36, 38, 39, 41, 42, 43, 44, 46, 47, 48, 59, 64, 72, 88, 89, 91, 92, 94, 101, 103, 110, 119, 121, 123, 131, 167, 180, 181, 182, 183, 184, 185, 195, 202
Craycroft, Road or wash	S-1, S-7, S-8, 1,6, 14, 18, 19, 21, 31, 35, 41, 44, 52, 56, 67, 68, 79, 84, 86, 88, 102, 133, 135, 159, 177, 190
cubic, feet per second or yards	36, 82, 139, 163, 203
Dodge Boulevard	S-6, 18, 30, 31, 39, 56, 84, 115, 124, 133, 158, 159, 177, 186, 204
Ecosystem Functional Assessment (EFA) Procedure	10, 1925, 52, 53, 54, 57, 64, 70, 76, 80, 88, 89, 90, 92, 94, 161, 173, 174, 179, 181
Finger Rock Wash	S-5, S-6, S-7, 21, 23, 25, 26, 27, 30, 31, 36, 38, 39, 43, 54, 56, 57, 59, 64, 66, 67, 68, 74, 135, 152, 161, 167, 172, 175, 177, 183, 186, 187, 198, 200, 201, 202, 205
Flecha Caida Wash	S-7, 32, 34, 43, 46, 52, 56, 68, 135
functional capacity index (FCI)	71, 72, 74, 75, 76, 81, 82, 90, 91, 92, 173, 174, 175, 180, 181
gabion(s)	Abstract, S-5, S-6, S-7, 23, 25, 26, 27, 34, 35, 36, 38, 42, 43, 44, 49, 52, 53, 54, 56, 57, 59, 64, 74, 75, 174, 176, 182, 184, 185, 186, 190, 200, 202, 205, 211, 218, 219
gallery forest	3, 8, 12, 15, 89
grade control structures	S-1, 25, 41, 44, 67, 81, 84
groundwater, or ground water	S-1, S-6, 7, 14, 15, 17, 18, 20, 47, 59, 66, 67, 78, 79, 80, 83, 94, 108, 116, 156, 161, 173, 176, 179, 180, 200, 218
hackberry	S-8, S-9, 30, 38, 47, 48, 89, 100, 102, 104, 115
Hill Farm basin	32, 34, 35, 43, 44
hydrogeomorphic assessment (HGM)	S-7, S-8, 10, 70
incidental benefits	Abstract, S-3, S-4, 64, 167, 188, 189, 192, 195, 203, 204, 205, 216, 217
incidental reduction of storm water damage	Abstract, S-2, 4, 48, 63
incremental cost analysis	S-3
inflatable barriers	23, 25, 44, 46, 53
invasive plants	S-2, 8, 34, 35, 75, 123, 211

irrigation	S-6, S-7, S-8, S-9, 20, 21, 23, 36, 38, 41, 42, 47, 48, 49, 50, 68, 77, 79, 148, 149, 169, 171, 177, 198, 212, 218
irrigation channels in Binghampton	Abstract, 38, 151
landfill	18, 123, 124, 156, 161, 203
mesquite	Abstract, S-1, S-5, S-6, S-7, S-8, 3, 4, 8, 11, 16, 19, 21, 27, 30, 31, 32, 34, 35, 36, 38, 39, 41, 46, 47, 48, 49, 52, 59, 60, 64, 68, 74, 89, 91, 94, 101, 102, 103, 105, 106, 108, 110, 113, 115, 116, 123, 130, 131, 175, 181, 182, 183, 184, 185, 189, 200, 201, 202
minor consequences, effects, or impacts	Abstract, 68, 156, 161, 172, 173, 187, 188, 194, 196, 200, 201, 202, 203, 204, 216
Mormon	S-6, S-8, 20, 50, 149, 151
national	13, 60, 137, 142, 146, 207, 210
National Ecosystem Restoration or NER	S-2, 4, 13
National Environmental Policy Act or NEPA	S-1, S-4, 9,59, 145, 163, 207, 210
National Historic or National Register	10, 11, 145, 146, 149, 151, 152, 153, 198, 199
natural resources	6, 11, 127, 133, 139
no action alternative	Abstract, S-4, 15, 25, 59, 163, 167, 172, 173, 176, 177, 179, 180, 186, 187, 188, 189, 191, 192, 193, 194, 196, 200, 201, 202, 203, 205
Pantano Wash	S-1, 1, 14, 19, 20, 44, 67, 77, 78, 79, 83, 133, 135, 149, 183, 184, 219
parks	S-6, 11, 18, 21, 36, 38, 49, 79, 124, 127, 132, 133, 135, 136, 137, 138, 139, 140, 141, 186, 187, 188, 191, 192, 201, 203
reclaimed water	S-6, S-7, S-8, 7, 17, 21, 50, 68, 79, 158, 166, 176, 177, 202, 218, 220
restoration alternatives	Abstract, S-2, S-3, 9, 10, 52, 54, 68, 73, 163, 172, 173, 176, 177, 178, 180, 181, 184, 186, 187, 188, 189, 190, 192, 193, 194, 195, 196, 200, 201, 202, 203, 204, 208, 209, 210, 211, 216, 217
Rillito River	Abstract, S-1, S-2, S-4, S-5, S-6, S-7, 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 18, 19, 20, 21, 23, 27, 30, 31, 32, 33, 36, 38, 41, 42, 44, 46, 52, 59, 66, 67, 68, 70, 71, 72, 77, 78, 80, 81, 82, 84, 86, 88, 89, 130, 135, 136, 167, 172, 173, 175, 177, 178, 179, 181, 182, 183, 186, 187, 188, 190, 191, 192, 196, 201, 203, 205, 209, 214, 216, 217, 219
riparian ecosystem	S-2, 3, 4, 9, 41, 57, 64, 66, 67, 70, 88, 91, 178, 180, 182, 192
riparian habitat	S-1, S-2, 23, 86, 89, 111, 136, 140, 175, 178, 187
river bottom	S-8, S-9, 8, 42, 44, 46, 49, 75, 81, 91, 130, 163, 173, 176, 178, 186, 188, 189, 195, 196, 200, 211
saltbush	S-9, 46, 48, 100, 102
Santa Catalina Mountains	S-9, 1, 2, 67, 83, 88, 130, 132, 183
Santa Cruz River	S-1, 5, 6, 19, 67, 77, 79, 91, 133, 135, 147, 183, 184, 218, 219
seep willow	S-9, 48, 100, 103
sensitive species	23, 107, 108, 109, 110, 111, 112, 113, 116, 117, 178, 180, 181, 184, 185

soil cement	Abstract, S-1, S-6, S-7, S-8, 8, 13, 25, 26, 27, 28, 30, 31, 32, 34, 39, 52, 59, 66, 67, 71, 74, 77, 78, 81, 82, 84, 94, 102, 111, 130, 133, 161, 163, 166, 167, 168, 171, 172, 174, 175, 179, 184, 195, 205
Sonoran Desert	3, 8, 9, 11, 47, 70, 72, 140, 142, 215
species diversity	S-2, S-8, 8, 23, 75, 90, 105, 107, 178, 179, 180, 181
surface water	S-1, S-2, S-6, S-7, 5, 20, 41, 50, 66, 67, 72, 74, 81, 88, 112
Swan Road	S-7, S-8, 21, 34, 41, 42, 52, 74, 91, 103, 124, 159, 175, 200
Swan to Alamo Wash basin	34, 43, 56
Sycamore	S-8, 48
Tanque Verde Wash	S-1, 1, 19, 44, 67, 72, 77, 79, 83, 133, 135, 149, 183, 184, 219
terraces	Abstract, S-5, S-6, 21, 23, 25, 26, 27, 28, 36, 39, 40, 41, 47, 48, 49, 52, 54, 56, 57, 59, 60, 61, 62, 63, 70, 74, 75, 76, 89, 92, 102, 156, 161, 163, 164, 166, 167, 169, 171, 172, 174, 175, 182, 183, 184, 185, 186, 187, 188, 190, 195, 201, 202, 203, 205, 218
U.S. Fish and Wildlife Service	S-4, 10, 11, 88, 107, 112, 207, 209
vegetation communities	S-5, S-6, 23, 28, 34, 39, 41, 42, 43, 44, 46, 47, 49, 50, 52, 57, 59, 64, 64, 86, 92, 94, 95, 96, 97, 98, 99, 105, 107, 130, 165, 176, 179, 181, 182, 183, 188, 189, 190, 202, 218, 220
water quality	Abstract, S-3, 78, 80, 173, 175, 206, 215
water table	20, 47, 66, 72, 74, 79, 81, 88, 94, 174
watershed	8, 19, 47, 67, 88, 123, 218
wildlife species	S-3, 23, 86, 105, 106, 108, 109, 110, 111, 112, 113, 115, 116, 118, 141, 179, 181, 182, 183, 185
willow(s)	S-1, S-5, S-6, S-7, S-8, S-9, 8, 19, 21, 23, 27, 31, 32, 34, 35, 36, 38, 39, 41, 42, 43, 44, 46, 47, 48, 52, 59, 64, 72, 89, 91, 92, 94, 100, 102, 103, 108, 115, 119, 121, 123, 131, 136, 180, 181, 182, 183, 184, 185, 195, 202

ATTACHMENTS

ATTACHMENT A

Pursuant to Clean Water Act of 1972, § 404
404(b)(1) Evaluation of Effects on Waters of the United States

1 Evaluation of the Effects of the Discharge or Dredged or Fill Materials in Waters of the United States

The following is provided I accordance with Section 404(b)(1) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) as amended by the Clean Water Act of 1977 (Public Law 95-217)(CWA). The intent of this document is to succinctly state and evaluate information regarding the effects of discharge of dredged or fill material into the waters of the United States. As such, it is not meant to stand-alone and relies heavily on information provided in the environmental document to which it is attached. Use of the "Documentation" category is for expansion of discussions only when necessary or for references and citation.

1.1 Project Description

1.1.1 Project Location and Environmental Setting

The study area is located in Pima County, Arizona. The Rillito flows from its beginning at the confluence of Tanque Verde Creek and Pantano Wash for a total of 12.2 river miles to the Santa Cruz River. The Rillito flows into the Santa Cruz River 7.6 miles downstream from the study area after flowing under Interstate 10. The Rillito drains the Southern side of the Santa Catalina Mountain that reaches elevations over 9000 ft. It also brings waters from the Northern edge of the Rincon Mountains that reach elevations up to 7000 ft.

The study area extends along the Rillito between Craycroft Road downstream to Campbell Avenue for a project length of approximately 4.8 miles. The study area averages one mile wide, and encompasses approximately 1065 acres.

The El Rio Antiguo study area is characteristic of the Sonoran desert: hot and dry. The average annual daily maximum temperature is 82°F. Average annual daily minimum temperature is 54°F. Average precipitation is approximately 12 inches per year with 46 per cent of the rainfall occurring during the monsoon season from July to September. There is potential for snowfall in the month of January.

Precipitation is normally divided between the summer and winter seasons. Summer storms are typically local, high-intensity thunderstorms, and generally occur from July to September. Storms on record have produced 5 inches of rainfall in a 24-hour period. Winter storms are typically widespread cyclonic storms 254sediment concentrations. Winter flows have lower peak discharges and longer duration carrying smaller suspended sediment loads.

Design/regulatory discharges have been established and approved by various agencies including the Corps of Engineers for the Rillito. A 100 -year design discharge of 32,000 cfs is currently used and approved by FEMA (Federal Emergency Management Agency), Pima County Department of Transportation and Flood Control District (PCDTFCD), and the U.S. Army Corps of Engineers.

Several tributaries join the Rillito River reach between Craycroft Road and Campbell Avenue. Six tributaries joining the right (north) bank of the river reach are: Craycroft Wash, Flecha Caida Wash, Valley View Wash, Finger Rock Wash, Camino Real Wash and Campbell Wash. The left or south bank of the project reach receives flows from the three tributaries: Alamo Wash, Alvernon Wash and Christmas Wash. The drainage areas of the tributaries joining the north bank of the Rillito contain mountainous and foothill areas with steep slopes at the upper watersheds, while the lower watersheds are relatively flat with low-density mostly residential developments. In contrast, the tributaries joining the south bank of the Rillito drain highly urbanized areas within metropolitan City of Tucson, and have much flatter channel slopes.

Of these tributaries, the washes with soil cement gaps and potential as restoration sites are Craycroft Wash, Flecha Caida Wash, Valley View Wash, Alamo Wash, Alvernon Wash and Christmas Wash. Finger Rock Wash discharges are as sheet f low on the alluvial fan at the Bend Area and then into the Rillito.

The channel is covered bank to bank in the entire study area in the 2-year event.

1.1.2 General Description of Alternatives and Recommended Plan

1.1.2.1 Basins Alternatives

There are eight basins alternatives divided evenly between those with and without buffer. Each basin alternative includes establishment of high and low flow channels for Finger Rock Wash. They also include channel restoration measures with 12 gabions to encourage meandering, low flow channel in the bend area, and various planting of communities including cottonwood willow, mesquite, desert wash and emergents in the river channel. The main concept of the basins alternatives are a series of alternatives that focus on the excavation of basins with weep holes in the bend area, or downstream basins, and upstream basins, primarily where the washes empty into the Rillito. Basins were designed and located to exploit opportunities for storm water harvesting and, by virtue of their design, provide habitat areas, which could be efficiently irrigated using surface flow systems that mimic natural flood inundation. The downstream basins alternatives were varied to examine implementing one basin in the bend area, or implementing two basins in the bend area. This may be desirable to avoid cultural resource impacts. Planted areas include establishment of new riparian habitat as well as improvement of existing riparian areas. These planted areas will be irrigated. The features particular to each alternative are listed in Table1.

Table 1: Basin Alternatives

Alternative	Name	Description	Gross Investment/ Avg. Annual Cost (Including O&M)	Net Increase in Average Annual FCU
1A	All Basins 4	Two basins in the Bend Area Eight upstream basins Expanded and improved buffer areas	$88,769,908 $7,052,262	110
1B	All Basins 1	Two Basins in the Bend Area Eight upstream basins	$79,490,875 $6,469,559	107
1C	Upstream Basins 4	8 upstream basins Expanded and improved buffer areas	$78,578,474 $5,913,294	81
1D	Upstream Basins 1	8 upstream basins	$66,749,857 $5,171,886	78
1E	2 Downstream Basins 4	Two basins in the bend area Expanded and improved buffer areas	$83,425,095 $6,496,491	96
1F	2 Downstream Basins 1	Two basins in the bend area	$75,372,701 $5,990,965	95
1G	1 Downstream Basin 4	One basin in the bend area Expanded and improved buffer areas	$86,522,108 $6,818,550	105
1H	1 Downstream Basin 1	One basin in the bend area	$76,518,305 $6,193,205	103

Gross investment in Table1 includes costs of real estate, construction and interest during construction. Operation and Maintenance (O&M) includes the costs of annual O&M activities and the annualized costs of periodic O&M activities.

1.1.2.2 Terrace Alternatives

There are eight terrace alternatives divided evenly between those with and without buffer. Each basin alternative includes establishment of high and low flow channels for Finger Rock Wash. The terrace alternatives will include a high and low flow channel in the bend area, the eight upstream basins (with weep holes), primarily where the washes empty into the Rillito. Basins were designed and located to exploit opportunities for storm water harvesting and, by virtue of their design, provide habitat areas, which could be efficiently irrigated using surface flow systems that mimic natural flood inundation. Four of the terrace alternatives do not have any channel restoration measures (gabions), which may be desirable from an engineering perspective in order to avoid any impact to existing grade control structures in the Rillito. The other four terrace alternatives have 12 gabions in the channel for restoration. The terrace alternatives are differentiated from the other alternatives by the concept of implementing a series of terraces in the bend area. Terraces will be cut in to the existing soil cement bank at the height of flow during a five-year flood event (approximately four to five feet above the river bottom). The second terrace will be constructed to accommodate flows during a 10-year event and a third terrace will accommodate flows during a 20-year flood event. The first terrace, which will be 75 feet wide at the widest point, will be planted with plant species typical of desert wash vegetation communities. The second terrace will be planted with cottonwood willow vegetation and will be approximately 200 feet at its widest point. Plants typical of a mesquite bosque will be planted on the upper third terrace. The third terrace will be approximately three feet higher than the second terrace and be approximately 150 feet at its widest point. A reinforced 2:1 slope will be used between the second and third terrace and the upland side of the third terrace will be contoured up to the current height of the adjacent upland area on its boundary. The terraces will occupy the location of the previously described Dodge and Bend Basins. The two sets of terraces alternatives were varied to examine implementing one set of terraces in the bend area, or implementing two sets of terraces in the bend area. This may be desirable to avoid cultural resource impacts. All eight terrace alternatives include various planting of communities including cottonwood willow, mesquite, and desert wash vegetation in newly created PWAAs, as well as existing PWAAs. These planted areas will be irrigated. The features particular to each alternative are listed in Table 2 Gross investment in Table 2 includes costs of real estate, construction and interest during construction. Operation and Maintenance (O&M) includes the costs of annual O&M activities and the annualized costs of periodic O&M activities.

Table 2 Terrace Alternatives

Alternative	Name	Description	Gross Investment/ Avg. Annual Cost (Including O&M)	Net Increase in Average Annual FCU
2A	2 Terraces 4	Two Terraces in the Bend Area Eight upstream basins Expanded and improved buffer areas	$97,862,359 $7,365,018	91
2B	2 Terraces 1	Two Basins in the Bend Area Eight upstream basins	$87,495,093 $6,714,887	89
2C	1 Terrace 4	1 terrace in the Bend Area 8 upstream basins Expanded and improved buffer areas	$88,967,764 $6,778,719	92

Alternative	Name	Description	Gross Investment/ Avg. Annual Cost (Including O&M)	Net Increase in Average Annual FCU
2D	1 Terrace 1	1 terrace in the Bend Area 8 upstream basins	$77,833,901 $6,080,976	90
2E	2 Tergab 4	Two Terraces in the Bend Area Eight upstream basins Rillito Low Flow Channel Restoration Expanded and improved buffer areas	$99,230,153 $7,481,462	125
2F	2 Tergab 1	Two Terraces in the Bend Area Eight upstream basins Rillito Low Flow Channel Restoration	$91,324,927 $6,991,844	123
2G	1 Tergab 4	One Terrace in the Bend Area Eight upstream basins Rillito Low Flow Channel Restoration Expanded and improved buffer areas	$91,544,626 $6,970,503	122
2H	1 Tergab 1	One Terrace in the Bend Area Eight upstream basins Rillito Low Flow Channel Restoration	$80,915,522 $6,304,286	120

1.1.2.3 Channel/Tributary Restoration Alternatives

The channel and tributary restoration alternatives focus on the restoration of plant communities in the river channel and tributary areas. Eight gabions will be placed in the channel, along with three inflatable barriers. The inflatable barriers will be near existing grade control structures in the Rillito, and be placed at more of a perpendicular angle, to direction of flow compared to the gabions being placed at approximately a 45 degree angle. In addition, the inflatable barriers will help to maintain the low-flow channel location, directing flow away from establishing channel vegetation, create a meandering lower velocity channel in the sandy bottom and slow lower flows down to potentially hydrate channel vegetation. The inflatable barriers will be deflated during periods of flood flows equal to or exceeding the 10-year flood event. Other measures to be implemented under the channel restoration alternatives are the eight upstream basins with weep holes or weirs, both the high- and low-flow channels in the bend area, and various planting efforts including enhancement of existing PWAAS with plantings in cottonwood willow, mesquite, desert wash vegetation, cienega emergents in the tributary areas along the Rillito, and buffer communities. These planted areas will be irrigated. The features particular to each alternative are listed in Table 3. Gross investment in Table 3 includes costs of real estate, construction and interest during construction. Operation and Maintenance (O&M) includes the costs of annual O&M activities and the annualized costs of periodic O&M activities.

Table 3 Channel/Tributary Alternatives

Alternative	Name	Description	Gross Investment/ Avg. Annual Cost (Including O&M)	Net Increase in Average Annual FCU
3A	Chanbar 4a	Three inflatable barriers Low flow channel gabions Finger Rock Wash Channels Eight upstream basins Expanded and improved buffer areas	$74,084,540 $5,869,615	101
3B	Chanbar 1a	Three inflatable barriers Low flow channel gabions Finger Rock Wash Channels Eight upstream basins	$76,923,062 $6,043,560	99
3C	Chanbar 4b	Three inflatable barriers Low flow channel gabions Eight upstream basins Expanded and improved buffer areas	$61,110,854 $4,834,041	80
3D	Chanbar 1b	Three inflatable barriers Low flow channel gabions Eight upstream basins	$52,917,302 $4,320,245	78

1.1.2.4 Recommended Plan

The recommended plan, 2h above would consist of implementing terraces in the bend area, Finger Rock Wash high- and low-flow channels in the bend area, 12 gabions in the river channel, and basins at the confluences of most of the tributary washes and the Rillito River. The terrace would restore the hydrologic functions between the river channel and the terraces and provide mesquite, cottonwood, and scrub/shrub habitat. The Finger Rock Wash high- and-low-flow channels would guide water to the Rillito and provide water to the terraces, as well as provide additional mesquite, cottonwood, and scrub/shrub habitat. The gabions would facilitate establishment of and protect vegetation along the river. The gabions also would improve hydrologic functions by directing low flows and creating shallow backwater areas where vegetation communities would develop. The basins would function to slow and capture water from the washes during precipitation events. They would provide cottonwood, willow, and mesquite habitat, as well as improve important chemical and hydrologic functions, such as increasing water absorption, nutrient cycling, and filtration. Together, all of the measures that comprise the recommended plan maximize hydrologic functions, improve infiltration and water availability for vegetation communities, and provide habitat for a number of native wildlife species.

1.1.3 Least Environmentally Damaging Practicable Alternative

1.1.3.1 Environmental Damage

Because this is a restoration project, all of the action alternatives have the long-term goal of providing a net benefit to wildlife habitat and the environment. While there may be tradeoffs among different elements of the environment, alternative that result in significant adverse environmental impacts that cannot be mitigated or that require extensive mitigation are not considered viable. Minor mitigation measures may be recommended, buy most of these are temporary measures, such as best management practices during construction, or are integral to the overall design..

1.1.3.2 Practicability

Section 230.10(a) of 404(b)(1) guidelines state that "an alternative is practicable if it is available and capable of being done after taking into consideration costs, existing technology and logistics in light of overall project purposes."

The No-Action Alternative is not considered practicable because it does not meet the primary project objective to restore degraded habitat. The No-Action alternative does not provide a permanent gain in the ecosystem benefit within the project area, specifically to increase cover of native riparian habitat. Whereas, there will be no disturbance of existing vegetation under this alternative, it provides no impetus to prevent further environmental degradation of existing riparian and wetland habitat. As such, the No-Action alternative is not least damaging practicable alternative.

From an environmental standpoint, all of the action alternative provide benefits and meet project objectives to varying degrees. If correctly implemented, alternative 2E would provide the greatest habitat benefit. It does, however, require the greatest input of water and imported materials for construction. But because water will always be a scarce resource in the region where consumptive uses compete with the needs of biological resources, use of the available water must be appropriately balanced.

In the context of whether or not the alternatives developed for this project are practicable, all of them incorporate management measures that are feasible. Alternatives that are more complex and cover a larger area inevitably require greater effort to correctly implement, operate, and maintain, even if the local sponsor and the Corps can assume the cost.

Alternative 2h have been selected as the Recommended Plan because it meets the project goals of maximizing habitat benefit, does not place an excessive burden on water resources, and can also be reasonably managed by the local sponsors to ensure long-term success.

1.2 Authority and Purpose

This study has been conducted under two separate authorities provided by Congress. The first and most recent authority is provided by House Resolution 2425 (HR 2425), dated May 17,

1994 HR 2425 states:

"...the Secretary of the Army is requested to review reports of the Chief of Engineers on the State of Arizona...in the interest of flood damage reduction, environmental protection and restoration and related purposes."

The second authority is given in Public Law 761, Seventy-fifth Congress, known as Section 6 of the Flood Control Act of 1938. This authority, dated June 28, 1938, states:

"...the Secretary of War (now Secretary of the Army) is hereby authorized and directed to cause preliminary examinations and surveys...at the following localities:...Gila River and tributaries, Arizona..."

1.3 General Description of Dredged or Fill Material

Materials are needed to : 1) construct the terrace in the Bend area; 2) construct the weirs required for the 8 tributary basins; 3) restore the Rillito River low-flow channel.

The materials in the main channel of the Rillito River and the tributary washes in the study area are classified as Arizo-riverwash complex, deep excessively drained gravelly fine sands formed in mixed alluvium. These soils consist of loose sandy, gravelly, and stony material. It is so coarse that it does not support plant growth. This soil complex comprises about 90% of the study area.

The remaining soils on the banks and adjacent areas are classified as Glendale soils, which are deep, well-drained soils, formed in stratified alluvium. This soil type comprises about 10% of the study area.

No large areas of fill will be placed in the Rillito River. There will be a next export of approximately 210,000 cubic yards of soil cement and overbank alluvium removed as part of the terrace construction. All of this material will be disposed of off site at an approved facility. Any other soil 'fills' will result from grading in the river bottom. Structural fill, in the form of weirs and gabions will be placed in the river and

mouths of the tributaries. The final sizes of these structures will be determined during the final design phase, but the basal area of this fill is not expected to be more than 0.254 acres. The weirs will be formed of concrete and the gabions will either be constructed of wood or formed using a mix of large rocks and boulders wrapped in steel mesh.

1.4 Description of the Proposed Discharge Site and Disposal Methods

Some material will be taken from the site during the removal of exotic vegetation. The dredged material will consist primarily of sands, with some gravels and silts. A very small fraction of the material removed is expected to be organic, limited to the areas supporting stands of exotic invasive vegetation. This material will be disposed of off-site along with the exotic invasive vegetation. All other material generated during construction will be reused throughout the site, with a goal of balancing, to the extent practicable, all of the cuts and fills required to construct the project. Overall, however, there is expected to be a net-import of material into the project area to construct the required water-control and grade-control features.

Vegetation and soil will be removed by grubbing and grading and moved with front-end loaders to trucks to be transported to an off-site location authorized for the disposal of green wastes and soils outside the boundary of waters of the United States.

1.5 Timing and Duration of Discharge

Activities that my include the discharge or removal of material in the channel, such as site preparation, earth moving, grading, terracing, and weir construction, will be completed within a 6 month time frame. Activities such as exotic invasive plant control will likely occur outside this timeframe. Major construction activities; however, with be scheduled to avoid periods of precipitation. As a result, the bulk of the construction will occur from April to July and then from September to November to miss the rainy seasons.

1.6 Mitigation Analysis

The goal of this project is to restore riparian habitats along the Rillito River. The project will create functioning habitats within portions of the channel; therefore, mitigation for adverse environmental effects is minimal. These measures include best management practices for the protection of water quality and sediment control during construction, public notification of temporary traffic problems along disposal, ingress, and egress routes, and public education to minimize accidents and protect the restored areas. The majority of these measures are only required during construction and, potentially, periodic maintenance designed to ensure the continued viability of the restored habitat. No residual adverse environmental effects are expected because the proposed project is not expected to result in an increase in impervious surfaces (long-term stormwater management) population (long term traffic, growth, and related infrastructure issues), or other resource that would generate long-term adverse effects.

1.7 Factual Determinations

1.7.1 Disposal Site/Physical Substrate Determinations

Impact: _____N/A _____X_____INSIGNIFICANT _____SIGNIFICANT

1.7.1.1 Substrate Elevation and Slope

The relevant section of the study area slopes in generally a southwesterly direction from an elevation of 2,425 to 2,328 feet above mean sea level.

1.7.1.2 Sediment Type

The sediment in the channel consists of alluvial material (sand, sandy loam, silty loam, gravel and cobbles). Refer to Section 4.1.1.4 of the EIS for detailed soil descriptions. Approximately 95% of the bank area of the Rillito River has been coated with soil cement. Within the study area, there are 13 gaps in the soil

cement that correspond to tributary washes. Soils in these tributary washes are similar to those in the Rillito River.

1.7.1.3 Excavated /Fill Material Movement

Construction activities (e.g., creation of vegetated areas, terracing, bank armoring, weir placement, removal of exotic invasive species) will result in incidental movement of local soils and sediments into downstream areas during runoff-events. In addition, surface runoff and alluvial fan flows after construction will pick up loose soils and transport them downstream. Significant impacts would be reduced, however, by limiting the area of exposed soils during construction, completing earth-disturbing activities during the dry season, revegetation of exposed soil areas, implementing an erosion and sedimentation control plan that identifies best management practices (BMPs) appropriate for the study area. The erosion and sedimentation control plan is required as part of the stormwater pollution prevention plan (SWPPP) mandated by the National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges associated with construction activities.

1.7.1.4 Physical Effects on Benthos (burial, changes in sediment type, composition, etc.)

Currently, there is no perennial source of water that supports benthic organisms in the project area. Constructing the new habitat areas will be beneficial for benthic organisms because new habitat would be created.

1.7.1.5 Other Effects

Operation and maintenance activities to ensure adequate flood flow would require periodic inspections, mowing sediment removal, gabion replacement and repair, and channel side slope repair to maintain structural integrity and to preserve newly vegetated areas. These effects would be similar to those expected during construction, but on a substantially reduced level because they will be limited to the area being maintained and not spread throughout the entire project area.

1.7.1.6 Actions Taken to Minimize Impacts

An Erosion and Sedimentation Control Plan will be prepared for project construction. The plan will also address BMPs for operation and maintenance activities. The BMPs identified in the Erosion and Sedimentation Control Plan would incorporate measures to minimize on-site and off-sire erosion. With implementation of the plan, potential impacts to water resources would be reduced to less-than-significant levels.

1.7.2 Water Circulation, Fluctuation, and Salinity Determinations

Impact: _____N/A _____X_____INSIGNIFICANT _____SIGNIFICANT

1.7.2.1 Effect on Water Quality

The Rillito River currently support ephemeral flows that have been reduced by watershed controls. During flood flows, runoff from the surrounding lands drain into the channel. An NPDES permit will be required for the construction activities, and a SWPPP plan will be developed and implemented as part of that permit. The SWPPP along with the other measures discussed in the EIS and DPR for this project will reduce construction-related water quality impacts to a less-than-significant level. A second NPDES permit may be required for the application of herbicides to control exotic invasive vegetation as part of the long-term management of the site. The status and need for that second NPDES permit under Section 402 of the Clean Water Act, however, had not been fully defined by EPA Region 9 (currently administering the program for ADEQ) at the time the EIS for this project was prepared. As a result, the need for this permit will be reassessed before construction begins.

The potential also exists for impact to surface and groundwater quality from minor, chronic, or large-scale spills of hazardous and toxic materials during construction from both equipment and small storage areas

established on site. The SWPPP will also contain a spill prevention plan that properly identifies storage location and remediation measures for clean up.

1.7.2.2 Effect on Current Drainage Patterns and Circulation

The Recommended Plan would not substantially change the surface water hydrology or drainage patterns in or into the Rillito River. Hydraulic modeling (Appendix A to the Main Feasibility Study) shows that the conveyance capacity of the river and affected tributaries would not be significantly affected, i.e., that the standard project flood condition would be maintained.

1.7.2.3 Effect on Normal Water Level Fluctuations

Water levels vary seasonally as a result of precipitation-induced flows. Periodic flood events cause water levels to rise. For the Recommended Plan, water surface elevations within the channel will not be significantly affected by the incorporation of wetland and riparian area as demonstrated by the hydrologic modeling completed for the project (Appendix A to the Main Feasibility Study)

1.7.2.4 Salinity Gradients

The Recommended Plan will not have any impacts on salinity gradients because none exist in the study area.

1.7.2.5 Actions Taken to Minimize Effects

An Erosion and Sedimentation Control Plan will be prepared for project activities. The plan will also address BMPs for operation and maintenance.

1.7.3 Suspended Particulate, Turbidity Determinations at Disposal Site

Impact: _____N/A _____X_____INSIGNIFICANT _____SIGNIFICANT

1.7.3.1 Expected change in Suspended Particulate and Turbidity Levels in the Vicinity of Disposal Site

Exported disposal material will be taken off site to an authorized landfill. Short-term increases in suspended particulates and turbidity levels may occur locally during construction, if water is flowing. Construction will be stopped during flow events, to minimize these increases. As discussed above, an NPDES permit will be required for construction activities. The NPDES permit requires that a SWPPP be developed and implemented. Suspended particulate and turbidity impacts will be reduced and managed by implementing the requirements of the SWPPP.

1.7.3.2 Effects (degree and duration) on Chemical and Physical Properties of the Water Column

Construction materials such as concrete will be separated from flowing water when present. All spills in the channel will be contained, controlled, and cleaned up in accordance with the requirements of the SWPPP. The SWPPP developed for this project will contain a spill prevention, control, and clean up plan that will specify proper storage, handling, containment, and clean-up techniques and measures for potentially hazardous materials during construction. These measures are designed to minimize the probability of a spill and any resultant impacts.

1.7.3.3 Effects of Turbidity on Biota

Any flowing waters will be separated from construction activities; however, the ephemeral flows in the Rillito River and tributaries within the study area are generally of short duration and do not support aquatic biota. As a result, no adverse impacts are expected.

1.7.3.4 Actions Taken to Minimize Impacts

Refer to the three previous subsections for mitigation measures.

1.7.4 Contamination Determination

1.7.4.1 Contamination Determination

A field reconnaissance and records search was completed as part of the Hazardous, Toxic, and Radioactive Waste Framework Research for this project. Information was collected from a number of government and private sources including the U.S. Environmental Protection Agency, Arizona Department of Environmental Quality, Pima County Assessor's Office, City of Tucson, telephone directories, aerial photographs, and the Arizona Department of Water Resources. In addition, a FirstSearch environmental database report was completed. No national priority list (superfund) site records were found within the 1 mile search radius. One federal Comprehensive Environmental Response, Compensation and Liability Information System listed site, the Kliendale Industrial Park was found within the ½ mile search radius for these sites. The northern part of the park is located within the study area boundary. Four Resources Conservation and Recovery Act (RCRA) waste generators are located within or adjacent to the study area boundary. All are classified as conditionally exempt small quantity generations. There are 2 RCRA Compliance Facilities outside the study area boundary, but within a 1-mile search radius of the study area boundary. Twelve facilities with underground storage tanks wither within or adjacent to the study area. Twelve facilities with 19 recorded leaking underground storage tanks are located within a ½-miles radius of the study area boundary. All but two of these investigations have been completed. Four landfills are located within a ½-mil radius of the study area boundary: Columbus Landfill 1 and 2, Walnut Landfill, Cactus Landfill. Three of the landfills are completely outside the study area boundary; the fourth, Cactus Landfill, is partially within the study area boundary. Hydrology studies indicate that groundwater contamination has not been found downgradient of the Columbus Landfills.

Potential contaminants of concern identified at the sites listed above include solvents, petroleum hydrocarbons, polychlorinated biphenyls (PCBs), pesticides, metals, and asbestos.

1.7.4.2 Actions Taken to Minimize Impacts

No project activities were planned on or near the identified sites.

1.7.5 Aquatic Ecosystem and Organism Determination

1.7.5.1 Effects on Aquatic Ecosystems and Organisms

No permanent aquatic environment currently exists with the project area. The Rillito River supports ephemeral flows during precipitation events and during snowmelt, but these are not of sufficient duration to support a aquatic ecosystem. As a result, the proposed project would not have any adverse effects on aquatic ecosystems and organisms.

1.7.5.2 Actions Taken to Minimize Impacts

No mitigation measures were required.

1.7.6 Proposed Disposal Site Determinations

Because disposal material will not be placed in a perennial watercourse or waterbody, a mixing zone does not exist.

1.7.6.1 Determination of Cumulative Effects of Disposal or Fill on the Aquatic Ecosystem

The Recommended Plan, coupled with other ecosystem restoration projects in the area, would not contribute to negative cumulative impacts within the region for biological resources. Instead, the long-term result of this project in conjunction with the other regional restoration efforts would provide an overall

benefit. To minimize turbidity during construction, however, excavation would be limited during the winter months and surface water would be diverted away from the construction area.

1.7.6.2 Determination of Secondary Effects of Disposal or Fill on the Aquatic Ecosystem

The SWPPP would present adequate measures to reduce any sedimentation or turbidity effects on downstream aquatic ecosystems. The use of fill is for the purpose of restoration of suitable riparian habitat. As such, the fill material will be immediately stabilized with an application of a cover. No existing wetlands will be filled as part of implementing the proposed project.

1.8 Finding of Compliance

1.8.1 Adaptation of the 404(b)(1) Guidelines to this Evaluation

No significant adaptations of the 404(b)(1) guidelines were made relative to this evaluation.

1.8.1.1 Evaluation of the Availability of Practicable Alternatives to the Recommended Plan, which would have Less Adverse Impact on the Aquatic Ecosystem

Restoration of the project area may require incidental discharge of sediment into waters of the United States during construction. In addition, the weirs proposed at the mouths of the tributary washes. Because the restoration objectives cannot be met without these structures and because they have been sized and designed to minimize their overall footprint, the expected impacts to waters of the United States are expected to be minimal. The overall long-term impacts of this project will be beneficial because it will restore wetlands and aquatic habitat to an area currently devoid of such.

1.8.1.2 Compliance with Applicable Water Quality Standards

The proposed project will comply with water quality standard promulgated by the Arizona Department of Environmental Quality. An NPDES permit will be obtained before construction begins and a SWPPP will be prepared and followed.

1.8.1.3 Compliance with Applicable Toxic Effluent Standard or Prohibition under Section 307 of the Clean Water Act

Because potential toxic contaminants have not been identified in the project area, further investigation will not be required before construction begins. The three landfills on the outskirts of the study area will not be affected either directly by construction or indirectly by changes in the surrounding water table resulting from the irrigation and wetland construction. Because of these two factors, the proposed project is in compliance with Section 307 of the Clean Water Act.

1.8.1.4 Compliance with the Clean Air Act, as Amended 1990

As discussed in the EIS, short-term impacts on air quality are expected to occur during construction. These impacts are expected to be temporary emissions of dust, fumes and equipment exhaust. Best management practices will be used to minimize these emissions, and as a result, they are not expected to exceed the *de minimis* threshold. As a result, no adverse short-term or long-term effects are expected.

1.8.1.5 Compliance with the Federal Endangered Species Act

As discussed in the EIS, The Corps has determined that the proposed project will not have an effect upon the continued existence of any federally listed threatened or endangered species; therefore, the project is in compliance with this Act.

A review of the proposed project indicates that:

As evaluated in the EIS, the discharge associated with the Recommended Plan for restoration represents the least environmentally damaging practicable alternative, and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem.

___X___YES _____NO

The activity does not appear to 1) violate applicable water quality standards or effluent standards prohibited under the CWA, or 2) jeopardize the existence of Federally listed threatened or endangered species or designated marine sanctuary.

___X___YES _____NO

The activity will not cause or contribute to significant degradation of waters of the U.S., including adverse effects on human health; life stages of organisms dependent on the aquatic ecosystem; ecosystem diversity; productivity and stability; and recreational, aesthetic, and economic values.

___X___YES _____NO

Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.

___X___YES _____NO

Note: A negative response indicates that the proposed project does not comply with the guidelines

Section 404(r) of the Clean Water Act exempts Federal projects from the Section 404 regulatory program if they meet specific criteria. This project meets the criteria for 404(r) exemption such that it is (1) a Federal construction project that (2) requires congressionally authorized funds and (3) for which an EIS and a Section 404(b)(1) Evaluation have been prepared.

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Stephen A. Owens
Director

March 23, 2004

U.S. Army Corps of Engineers
Environmental Resources Branch
Attn: Michael J. Fink
3636 North Central Avenue, Suite 900
Phoenix, Arizona 85012-1939

Re: Draft Feasibility Study, El Rio Antiguo, Rillito River, Pima County, Arizona

Dear Mr. Fink:

The Arizona Department of Environmental Quality (ADEQ), Water Quality Division has reviewed the El Rio Antiguo, Draft Feasibility Study, for a proposed restoration of environmental degradation, flood control and related land and water resource problems in partnership with Pima County Flood Control, the non-Federal sponsor.

The selected restoration plan consists of the following activities:

- Construction of a set of terraces in the area known as the "Bend".
- Planting of Cottonwood/willow, mesquite, shrubs and grasses in the channel of the Rillito River, mouths of tributaries and water harvesting basins.
  Installation of a culvert and pipeline to allow flow behind the soil cement in 2-year and higher events to provide water for riparian plant communities along the north bank of the Rillito River.
- Construction of a high and low flow channel to support the mesquite community and connect the Finger Rock Wash to the Rillito River.
- Construction of water harvesting basins at each upstream tributary mouth; and
  Installation of a distribution system for effluent irrigation of planted vegetation during establishment and dry periods.

The U.S Army Corps of Engineers and/or Pima County are responsible for obtaining all other permits certifications and licenses that may be required by federal, state or local authorities. Other approvals include, but are not limited to: construction activities and dewatering of construction site to a surface water body (AZPDES Stormwater Permit), use of reclaimed wastewater for dust control or irrigation (Reclaimed Water Permit), and effluent discharges to the 25-year floodplain of the Rillito River or tributaries to the Rillito River (AZPDES Discharge Permit).

We have determined that the proposed El Rio Antiguo restoration project should comply with State surface water quality standards. The El Rio Antiguo project should not have a negative impact upon the chemical, physical or biological integrity of the Rillito River. We therefore concur with the 404(r) exemption for State 401 Water Quality Certification.

Our concurrence with the 404(r) exemption for these activities does not affect or modify in any way the obligations or liability of any person for any damages, injury, or loss resulting from an impacted area discharge. The Department may modify or withdraw its determination if the information relied upon is inaccurate or if the project is not implemented as proposed. If, in the future, the Department determines that discharges from the activities have caused or contributed to a violation of surface water quality standards, the Department may withdraw concurrence with the 404(r) exemption and require an Individual 401 Certification for the project. This concurrence is not intended to waive any other federal, state or local laws.

Sincerely,

Andrew Cajero-Travers
Surface Water Permits Unit

03/23/04
Date

cc: U.S. EPA, Wetlands Regulatory Office

SWPU04:0144

ATTACHMENT B

Letters of Coordination with U.S. Fish and Wildlife Service

1) Planning Aid Letter
2) Final Coordination Act Report

United States Department of the Interior

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply Refer to:

AESO/FA

July 3, 2002

Ms. Ruth Villalobos
Chief, Planning Division
U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, California 90053-2352

Dear Ms. Villalobos:

Enclosed is our draft Planning Aid Letter for the El Rio Antiguo Feasibility Study, Pima County, Arizona. Please review and provide any comments you may have by August 2, 2002, so we can finalize the report.

Sincerely,

Steven L. Spangle
Acting Field Supervisor

Enclosure

cc: Kathleen Bergmann, Planning Branch, Army Corps of Engineers, Phoenix, AZ

W:/MikeMartinez/Antiguotrans.wpd:cgg

n.b.: The Final Planning Aid Letter follows, not the Draft.

RECEIVED
JUL 10 2002
PLANNING DIVISION

AESO/FA May 22, 2003

Ms. Ruth Villalobos
Chief, Planning Division
U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, California 90053-2352

Dear Ms. Villalobos:

This Planning Aid Letter (PAL) presents the Fish and Wildlife Service's (Service) preliminary evaluation of potential environmental effects and habitat benefits associated with the U.S. Army Corps of Engineers' (Corps) El Rio Antiguo Feasibility Study. It is provided pursuant to the Fish and Wildlife Coordination Act (FWCA)(48 stat. 401, as amended; 16 U.S.C. 661 et seq.) but does not constitute the Service report under Section 2(B) of the FWCA. This PAL is based on coordination with the Arizona Game and Fish Department, literature research, file reviews, and comments and information provided by the Corps. Participation by the Service in development of the specific model selected to assess ecosystem functional characteristics of the study area and project-specific refinement of its components contributed to quantitative results. A more detailed evaluation of the methodology used to quantify and analyze ecosystem functional properties of the Rillito River, describe existing conditions, and evaluate future with and without project scenarios will be incorporated into our 2(B) report.

PROJECT DESCRIPTION

The study area is approximately 1,070 acres along the Rillito River in eastern Pima County, Arizona. The study area begins at Craycroft Road and ends approximately five river miles downstream at Campbell Road. It closely follows the existing south bank, but extends into overbank and historic flood plains on the Rillito's north side. The study area lies northeast of downtown Tucson.

Under authority of House Resolution 2425 of 1994, the Flood Control Act of 1938, and the Energy and Water Development Appropriation Act of 2001, the Corps is authorized to conduct feasibility studies for flood protection and environmental restoration in the State of Arizona in cooperation with a local non-Federal sponsor. The local sponsor for the El Rio Antiguo project is the Pima County Department of Transportation and Flood Control.

Project objectives are:

- increase quality of native riparian for plants and animals
- attract migratory birds into enhanced/restored habitats

- create a continuous biological corridor upstream and downstream
- create a functional migration corridor comprised of intermittent native suffrutescent perennials and gallery forest species
- create permanent habitat linkages between Finger Rock Wash and the Rillito River
- retain as much runoff as possible in soils of tributary washes and the river bottom
- foster good conditions for seed production, germination, early growth of plant species; and eventually have many different size classes represented in the project area
- reestablish native species to the study area and augment species diversity
- eliminate invasive and non-native plant species

EXISTING ENVIRONMENT

The Rillito River drainage is bounded on the north by the Santa Catalina Mountains, on the east by the Rincon Mountains, on the southeast by the Whetstone Mountains, on the south by the Empire Mountains, and on the west by the Santa Rita Mountains. The Rillito River begins at the confluence of Pantano Wash and Tanque Verde Creek which originate from the Santa Rita and Rincon Mountains, respectively. Elevation is 2,300 feet above mean sea level (MSL) at the confluence of the Rillito with the Santa Cruz River. Within the Study area, elevations drop gradually from 2440 feet at Craycroft Road to 2330 feet where Campbell Road crosses the Rillito. The Rillito runs primarily east to west along the edge of the foothills of the Santa Catalina Mountains. It is an ephemeral watercourse, flowing mainly during the months of July, August, and September in response to monsoon thunderstorms. It has become markedly incised as land use in the region changed historically. Nearly the entire length of the river is hemmed in by soil cement and channelized in appearance and hydraulic behavior. The Rillito has a sandy channel with widths that range between 300 and 400 feet.

Vegetation communities within the El Rio Antiguo study area include Sonoran desert scrub, mesquite bosque, Sonoran deciduous riparian scrubland, and Sonoran interior strand. Species include foothill paloverde (*Cercidium microphyllum*), velvet mesquite (*Prosopis velutina*), creosote bush (*Larrea tridentata*), saguaro (*Carnegeia gigantea*), cholla (*Opuntia* spp.), desert broom (*Baccharis sarothroides*), vine mesquite (*Panicum obrosum*), saltbush (*Atriplex* spp.), desert hackberry (*Celtis pallida*), desert willow (*Chilopsis linearis*), Bermuda grass (*Cynodon dactylon*), burrobrush (*Hymenoclea monogyra*), salt cedar (*Tamarix* spp.), Fremont cottonwood (*Populus fremontii*), Gooding's willow (*Salix goodingii*), cocklebur (*Xanthium strumarium*), and rabbit's foot grass (*Polypogon monspeliensis*).

Native wildlife species found in the project area likely include coyote (*Canis latrans*), kangaroo rats (*Dipodomys* spp.), black-tailed jackrabbit (*Lepus californicus*), cottontail (*Sylvilagus*

audubonii), pocket mice (*Perognathus* spp.), ground squirrels (*Ammospermophilus spp.*), black-chinned sparrow (*Amphispiza bilineta*), roadrunner (*Geococcyx californianus*), Gambel's quail (*Lophortyx californicus*), Harris' hawk (*Parabuteo unicinctus*), curve-billed thrasher (*Toxostoma curvirostre*), Gila woodpecker (*Melanerpes uropygialis*), cactus wren (*Campylorhynchus brunneicapillus*), common raven (*Corvus corax*), canyon towhee (*Pipilo fuscus*), mourning dove (*Zenaida macroura*), whiptails (*Cnemidophorus* spp.), rattlesnakes (*Crotalus* spp.), horned lizards (*Phrynosoma* spp.), and lizards (*Urosaurus* spp.). We are unaware of the occurrence any federally threatened or endangered species within the project area.

ALTERNATIVES

Descriptions of conditions as they are now, and as they could be with implementation of the recommended plan for this Feasibility Study, have roots in the abiotic and biotic interactions which drive ecological processes integral to riparian ecosystems. The amalgam of them all leads to the defining association of hydrology and hydraulics which together shapes the land in the river bottom, bring surface runoff into the Rillito, propels nutrient cycles, and promotes environmental conditions suitable for plant and animal species recognizable as a riparian habitat community. This Study sets out and evaluates alternatives whose net effect would be to mimic as many of the basic ecosystem processes as possible.

General goals and objectives have been identified. These include restoration of cienega and riparian vegetation, restoration of wildlife habitat, maximization of water retention in appropriate soils where native species would be planted, optimization of biological diversity, minimization of disturbance, restoration of self sustenance and resilience, minimization of maintenance needs, prevention of feral predation, and maintenance of a vector control program.

WITHOUT PROJECT PROJECTION

In the absence of active restoration efforts, it is unlikely that significant wetland or hydro-riparian vegetation would become established within this reach of the Rillito River. Due to effects of regional groundwater pumping and channelization, it is unlikely this stretch of the Rilltio would ever exhibit the appropriate hydrogeomorphic conditions to support significant vegetation. Water would flow in the project area only in response to storm-water runoff, and retention on-site would be minimal.

WITH PROJECT PROJECTION

Implementation of the proposed project could enhance and restore native vegetation communities and wildlife habitats the Rillito River. The specific nature and configuration of water source and native vegetation has yet to be determined. However, a steady supply of treated reclaimed water will be the basis for all supplemental irrigation requirements. That water

will be released in a flood-style manner, rather than a plumbed distribution system to deliver water to individual plants. Accordingly, the opportunity exists to provide habitat for a diversity of native wildlife species.

DISCUSSION

The most important aspect of riparian restoration is the attainment and proper utilization of a secure water source to ensure adequate hydrologic conditions to support the desired biotic communities. Several parameters that should be used to describe proper hydrologic condition include hydroperiod, water depth, and seasonal flood pulses. Accordingly, project design should focus on securing a permanent and sufficient source of water. A combination of effluent, groundwater, and storm water may be beneficial.

Prior to active restoration, assessments should be conducted to ensure that chosen sites would be suitable environments for the establishment, regeneration, and survival of native riparian plants. Consideration should be given to microhabitat conditions such as depth to water table, soil texture, and salinity. Consideration should also be given to large scale ecological processes such as flood regime which species such as cottonwood and willow depend upon for seed bed formation, seed dispersal, germination, seedling establishment, recruitment, and survival. Other considerations may include groundwater fluctuations, site preparation, protection of plantings from herbivory, necessity of irrigation, potential for competition from undesirable species, and long term management potential for the site.

PRELIMINARY RECOMMENDATIONS

1) Focus significant attention on identifying and, if necessary, securing a permanent and adequate source of water to support the desired biotic communities.

2) Conduct assessments to ensure that site specific microhabitat conditions would be conducive to establishment and growth of native riparian plants; especially cottonwood, willow, and mesquite.

We appreciate the opportunity to provide planning assistance for this proposed project. We look forward to working with you on continued project development. If we can be of further assistance or you have questions, please contact Mike Martinez (x224).

Sincerely,

Steven L. Spangle
Acting Field Supervisor

cc: Supervisor, Project Evaluation Program, Arizona Game and Fish Department, Phoenix, AZ
Kathleen Bergmann, Planning Branch, Army Corps of Engineers, Phoenix, AZ

United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 242-0210 FAX: (602) 242-2513

In Reply Refer to:
AESO/FA

March 25, 2004

Ms. Ruth Villalobos
Chief, Planning Division
U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, California 90053-2352

Dear Ms. Villalobos:

The Fish and Wildlife Service (FWS) has reviewed the U.S. Army Corps of Engineers (Corps) El Rio Antiguo Feasibility Study. This report represents our evaluation of the El Rio Antiguo ecosystem restoration project and is provided pursuant to Section 2(B) of the Fish and Wildlife Coordination Act (FWCA)(48 stat. 401, as amended; 16 U.S.C. 661 et seq.). This report is based on coordination with the Arizona Game and Fish Department, literature research, file reviews, and information provided by the Corps including the April, 2003, Feasibility Study AFB Report and the April, 2003, Preliminary Draft Environmental Impact Statement (EIS).

PROJECT DESCRIPTION

Under authority of House Resolution 2425 of 1994, the Flood Control Act of 1938, and the Energy and Water Development Appropriation Act of 2001, the Corps is authorized to conduct feasibility studies for flood protection and environmental restoration in the State of Arizona in cooperation with a local non-Federal sponsor. The local sponsor for the El Rio Antiguo project is the Pima County Department of Transportation and Flood Control (County).

The study area lies along the Rillito River in Pima County, Arizona. The Rillito flows from its beginning at the confluence of Tanque Verde Creek and Pantano Wash for a total of 12.2 river miles to the Santa Cruz River. The Rillito flows into the Santa Cruz River 7.6 miles downstream from the study area and drains the southern portion of the Santa Catalina Mountains and the northern edge of the Rincon Mountains. Figure 2.1 in the AFB Report presents the general project study area location and Figure 2.2 in that report shows the specific study area vicinity. The study area extends along the Rillito from Craycroft Road downstream to Campbell Avenue. The study area encompasses approximately 1066 acres.

The specific objectives for environmental restoration within the study area have been identified in the AFB Report as follows:

- Restoration of a diversity of wildlife species habitats,

- restoration of El Rio Antiguo to a more natural condition through the planting of plant species that are native to and occurred historically in riparian streams and washes in the region,
- increase of recreation opportunities to the extent they do not adversely affect restoration,
- contribute to other qualitative environmental quality objectives, and
- reduce flooding through incidental effects to the extent that restoration it is not adversely affected.

EXISTING ENVIRONMENT

As stated above, the Rillito River begins at the confluence of Pantano Wash and Tanque Verde Creek which originate from the Santa Rita and Rincon Mountains, respectively. Elevation is 2,300 feet above mean sea level at the confluence of the Rillito with the Santa Cruz River. Within the Study area, elevations drop gradually from 2440 feet at Craycroft Road to 2330 feet where Campbell Road crosses the Rillito. The Rillito runs primarily east to west along the edge of the foothills of the Santa Catalina Mountains. It is an ephemeral watercourse, flowing mainly during the months of July, August, and September in response to monsoon thunderstorms.

Water once flowed perennially along the El Rio Antiguo reaches of the Rillito and supported substantial growth of native riparian vegetation. Historical accounts from approximately 100 years ago describe a tree-lined, narrow river with dense vegetation winding throughout the riverbed and vicinity. In the 1850's, the river channel was lined with trees and grasses along the riverbanks and flood plain. The river was obstructed by numerous beaver dams that ponded water and encouraged the development of wetlands. Riparian plant species included cottonwood (*Populus fremontii*), mesquite (*Prosopis juliflora*), seep willow (*Baccharis glutinosa*), hackberry (*Celtis pallida*), and desert willow (*Chilopsis linearis*). Historically, fluvial processes such as bank aggradation and channel meandering created environmental conditions such as water table depth and inundation frequency that were favorable to the survival of diverse native riparian communities.

Throughout the 20th Century, the rate of groundwater pumping to support agricultural development and urban settlement exceeded the rate of natural recharge. Today only a few vestiges of riparian islands remain. The Rillito River now flows only in response to storm water events and much of the channel is incised and confined by soil cement.

Current vegetation communities within the El Rio Antiguo study area are limited but include Sonoran desert scrub, mesquite bosque, Sonoran deciduous riparian scrubland, and Sonoran interior strand. Species include foothill paloverde (*Parkinsonia microphylla*), velvet mesquite (*Prosopis velutina*), creosote bush (*Larrea tridentata*), saguaro (*Carnegeia gigantea*), cholla (*Cylindropuntia* spp.), desert broom (*Baccharis sarothroides*), vine mesquite (*Panicum obrosum*), saltbush (*Atriplex* spp.), desert hackberry (*Celtis pallida*), desert willow (*Chilopsis linearis*), Bermuda grass (*Cynodon dactylon*), burrobrush (*Hymenoclea monogyra*), salt cedar

(*Tamarix* spp.), Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), cocklebur (*Xanthium strumarium*), and rabbit's foot grass (*Polypogon monspeliensis*).

Native wildlife species found in the project area likely include coyote (*Canis latrans*), kangaroo rats (*Dipodomys* spp.), black-tailed jackrabbit (*Lepus californicus*), cottontail (*Sylvilagus audubonii*), pocket mice (*Perognathus* spp.), ground squirrels (*Ammospermophilus spp.*), black-chinned sparrow (*Amphispiza bilineata*), roadrunner (*Geococcyx californianus*), Gambel's quail (*Callipepla Gambelii*), Harris' hawk (*Parabuteo unicinctus*), curve-billed thrasher (*Toxostoma curvirostre*), Gila woodpecker (*Melanerpes uropygialis*), cactus wren (*Campylorhynchus brunneicapillus*), common raven (*Corvus corax*), canyon towhee (*Pipilo fuscus*), mourning dove (*Zenaida macroura*), whiptails (*Cnemidophorus* spp.), rattlesnakes (*Crotalus* spp.), horned lizards (*Phrynosoma* spp.), and tree lizards (*Urosaurus* spp.).

The study area is located within the urban areas excluded from survey recommendations for the endangered cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*).

ALTERNATIVES

The El Rio Antiguo feasibility study process involved successive iterations of alternative solutions to the defined ecosystem degradation problem. Those solutions were based on the study objectives and designed to address opportunities while remaining within the limitations imposed by recognized constraints. Plans were analyzed using a functional assessment method developed from the Hydrogeomorphic Approach to wetland assessment. This methodology strives to model the functional components of a wetland ecosystem by identifying and quantifying criteria (i.e. geomorphic setting, water source, and hydrodynamics) that influence those functions. The following is the final array of alternatives determined by incremental cost analysis. For a more detailed description of the final array of alternatives, including maps and figures, we refer the reader to the AFB Report and Draft EIS.

No Action Alternative: Under this alternative, the Corps of Engineers would take no action to provide ecosystem restoration within the study area, nor to develop plans with potential incidental benefits associated with flood damage reduction, recreation, and water quality and supply.

Alternative 2H: This is the Corps' recommended plan and would focus on construction of one set of terraces in the river bend area (between Dodge and Country Club Roads), a low/high flow watercourse, and eight basins (all upstream of Dodge Road) designed to harvest stormwater. In addition, 12 gabions would be constructed in the river channel to facilitate vegetative growth. Plant community restoration would include development of new and enhancement of existing cottonwood-willow forest, mesquite bosque, scrubshrub association, and riverbottom systems. Plantings would be irrigated. Development would include 150 acres of mesquite bosque, 22 acres of scrubshrub, 62 acres of cottonwood/willow, and 12 acres of emergent vegetation in the riverbottom.

Alternative 2F: This alternative would focus on two sets of terraces in the bend area, a low/high flow watercourse, and eight upstream basins. In addition, 12 gabions would be constructed in

the river channel. Plant community restoration would include development of new and enhancement of existing cottonwood-willow forest, mesquite bosque, scrubshrub association, and riverbottom systems. Acreage would be similar to that described in alternative 2H.

Alternative 2E: This alternative is the same as Alternative 2F, except that buffer areas would be developed around restored habitats, and existing areas that serve as a buffer would be enhanced with plantings.

WITHOUT PROJECT PROJECTION

In the absence of active restoration efforts, it is unlikely that significant wetland or hydro-riparian vegetation would become established within this reach of the Rillito River. Due to effects of regional groundwater pumping and channelization, it is unlikely this stretch of the Rilltio would ever exhibit the appropriate hydrogeomorphic conditions to support significant vegetation. Water would flow in the project area only in response to storm-water runoff and retention on-site would be minimal.

WITH PROJECT PROJECTION

Implementation of the proposed project would enhance and restore native vegetation communities and wildlife habitats the Rillito River. The interagency-constructed HGM model was used to forecast annual average functional capacity units (AAFCUs) that would be provided by each of the alternatives. These numbers can be interpreted as the relative environmental outputs of each plan. AAFCUs that would be provided by each alternative are as follows: 2H, 119.66; 2F, 123.07; and 2E, 124.61.

DISCUSSION

The FWS is pleased to participate in this planning process for a native riparian community restoration project in Arizona. As stated in our planning aid letter (PAL), we believe the most important aspect of riparian restoration is the attainment and proper utilization of a secure water source to ensure adequate hydrologic conditions to support the desired biotic communities. We support the utilization of reclaimed water and harvested stormwater in these efforts.

Also, as previously stated in our PAL, we believe that prior to active restoration, assessments should be conducted to ensure that chosen sites would be suitable environments for establishment, regeneration, and survival of native riparian plants. Although irrigation would be available, we continue to support efforts to locate vegetation in sites where groundwater conditions may eventually allow plants to sustain themselves. We believe the planning process is adequately evaluating and pursuing this approach.

In addition to implementing strategies to improve the potential success of restored habitats, the Corps should proceed with restoration in a manner that minimizes or eliminates potential adverse effects on existing biological resources. This proposal could benefit from the inclusion of conservation measures to track and evaluate the long-term status of threatened and endangered species and their habitats in the study area. We encourage the local non-Federal sponsor(s) to

initiate discussions with the FWS regarding potential development of a project-level Safe Harbor Agreement for future operation and maintenance activities that may affect listed species or their habitats. Such an effort could greatly facilitate operation and maintenance of the project while providing conservation benefits to listed species.

Finally, in regard to the HGM model, although we support the process and outputs generated for this project, we encourage the Corps to work with the FWS and AGFD to evaluate the potential to simplify the HGM methodology for future projects within Arizona.

RECOMMENDATIONS

1) Continue efforts to secure effluent and storm water to support the desired biotic communities.

2) Continue to evaluate site-specific conditions to ensure appropriate establishment and growth of native riparian plants.

3) Encourage the local sponsor to coordinate with the FWS regarding development of conservation measures that would minimize effects on listed species of future operation and maintenance activities.

4) Work with the FWS and AGFD on a programmatic basis to simplify the HGM methodology for future restoration within the State of Arizona.

We appreciate the opportunity to provide planning assistance for this proposed project. If we can be of further assistance or you have questions, please contact Mike Martinez (x224).

Sincerely,

for

Steven L. Spangle
Field Supervisor

cc: Supervisor, Project Evaluation Program, Arizona Game and Fish Department, Phoenix, AZ
Kathleen Bergmann, Planning Branch, Army Corps of Engineers, Phoenix, AZ

W:\Mike Martinez\AntiguoReport.doc:cgg

ATTACHMENT C

Comments and Responses on the Draft EIS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

February 4, 2004

John E. Moeur
U.S. Army Corps of Engineers
915 Wilshire Boulevard
Los Angeles, CA

Subject: Draft Environmental Impact Statement (DEIS) for the El Rio Antiguo Restoration Feasibility Study (CEQ#030559)

Dear Mr. Moeur:

The Environmental Protection Agency (EPA) has reviewed the above referenced document pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

EPA supports the objectives of the proposed El Rio Antiguo Restoration project. In our review of the document, we found that the DEIS sufficiently addresses the environmental impacts of the proposed alternative. As such, EPA has rated this document Lack of Objections (LO). Please see the enclosed Rating Factors for a description of EPA's rating system.

While EPA has no objections to the proposed project, we request some clarification in the Final EIS regarding the recreation improvements proposed as part of the El Rio Antiguo project. Specifically, the Final EIS should identify the exact type and location of trail and parking improvements in the study area. The document should reflect awareness that not all recreational activities are compatible with restoration of terrestrial and aquatic habitats, and should outline strategies for reducing human impacts in restoration and sensitive habitat areas.

We appreciate the opportunity to review this DEIS. When the Final EIS is released for public review, please send two copies to the address above (mail code: CMD-2). If you have any questions, please contact me or Shanna Draheim, the lead reviewer for this project. Shanna can be reached at (415) 972-3851 or draheim.shanna@epa.gov.

Sincerely,

Lisa B. Hanf, Manager
Federal Activities Office

Enclosures: EPA Summary Rating Sheet

Printed on Recycled Paper

RESPONSE

Comment noted. The exact type and location of trail and parking improvements will be reviewed and analyzed in more detail during the Pre-construction Engineering Design segment of the Plans and Specification phase, once Congress gives authorization to proceed.

AESO/FA July 9, 2003

Ms. Ruth Villalobos
Chief, Planning Division
U.S. Army Corps of Engineers, Los Angeles District
P.O. Box 532711
Los Angeles, California 90053-2352

Dear Ms. Villalobos:

The Fish and Wildlife Service (FWS) has reviewed the U.S. Army Corps of Engineers (Corps) El Rio Antiguo Feasibility Study. This report represents our evaluation of the El Rio Antiguo ecosystem restoration project and is provided pursuant to Section 2(B) of the Fish and Wildlife Coordination Act (FWCA)(48 stat. 401, as amended; 16 U.S.C. 661 et seq.). This report is based on coordination with the Arizona Game and Fish Department, literature research, file reviews, and information provided by the Corps including the April, 2003, Feasibility Study AFB Report and the April, 2003, Preliminary Draft Environmental Impact Statement (EIS).

PROJECT DESCRIPTION

Under authority of House Resolution 2425 of 1994, the Flood Control Act of 1938, and the Energy and Water Development Appropriation Act of 2001, the Corps is authorized to conduct feasibility studies for flood protection and environmental restoration in the State of Arizona in cooperation with a local non-Federal sponsor. The local sponsor for the El Rio Antiguo project is the Pima County Department of Transportation and Flood Control (County).

The study area lies along the Rillito River in Pima County, Arizona. The Rillito flows from its beginning at the confluence of Tanque Verde Creek and Pantano Wash for a total of 12.2 river miles to the Santa Cruz River. The Rillito flows into the Santa Cruz River 7.6 miles downstream from the study area and drains the southern portion of the Santa Catalina Mountains and the northern edge of the Rincon Mountains. Figure 2.1 in the AFB Report presents the general project study area location and Figure 2.2 in that report shows the specific study area vicinity. The study area extends along the Rillito from Craycroft Road downstream to Campbell Avenue. The study area encompasses approximately 1066 acres.

RESPONSE

Prior to active restoration commencement, an assessment of the chosen restoration sites will be conducted to determine their suitability for the establishment and regeneration of native riparian plants. During pre-construction surveys, the recommended restoration site plant assemblages will be reviewed for their appropriateness for the project. As appropriate, this information will be added to the Feasibility Study, Chapter VI, Section F, and the Final Environmental Impact Statement, Chapter 3.7.

The affected environment of El Rio Antiguo has no primary constituent elements, which are essential to the conservation and recovery of the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*). Furthermore, the physical and biological features of the current habitat include a small disjunct polygon of cotton-willow woodland (less than 60 percent canopy closure), mesquite, and scrub-shrub landscapes. Most of the existing environmental conditions consist of river bottom sandy habitat, upland burr, and urban interface. Consequently, the project area lacks the necessary columnar cacti habitat component juxtaposed with suitable pygmy-owl habitat. Lastly, the Draft Feasibility Study and Environmental Impact Statement clearly states that the study area is located in an urban environment, and no known federal or State listed threatened or endangered species occur (Feasibility Study page IV-18, page V-2; EIS Chapter 4.5; and Attachment A – Species Accounts).

The specific objectives for environmental restoration within the study area have been identified in the AFB Report as follows:

- Restoration of a diversity of wildlife species habitats
- Restoration of El Rio Antiguo to a more natural condition through the planting of plant species that are native to and occurred historically in riparian streams and washes in the region
- Increase of recreation opportunities to the extent that they do not adversely affect restoration
- Contribute to other qualitative environmental quality objectives
- Reduce flooding through incidental effects to the extent that restoration it is not adversely affected

EXISTING ENVIRONMENT

As stated above, the Rillito River begins at the confluence of Pantano Wash and Tanque Verde Creek which originate from the Santa Rita and Rincon Mountains, respectively. Elevation is 2,300 feet above mean sea level at the confluence of the Rillito with the Santa Cruz River. Within the Study area, elevations drop gradually from 2440 feet at Craycroft Road to 2330 feet where Campbell Road crosses the Rillito. The Rillito runs primarily east to west along the edge of the foothills of the Santa Catalina Mountains. It is an ephemeral watercourse, flowing mainly during the months of July, August, and September in response to monsoon thunderstorms.

Along the El Rio Antiguo reaches of the Rillito, water once flowed perennially and supported substantial growth of native riparian vegetation. Historical accounts from approximately 100 years ago describe a tree-lined, narrow river with dense vegetation winding throughout the riverbed and vicinity. In the 1850's, the river channel was lined with trees and grasses along the riverbanks and flood plain. The river was obstructed by numerous beaver dams that ponded water and encouraged the development of wetlands. Riparian plant species included cottonwood (*Populus fremontii*), mesquite (*Populus juliflora*), seep willow (*Baccharis glutinosa*), hackberry (*Celtis pallida*), and desert willow (*Chilopsis linearis*). Historically, fluvial processes such as bank aggradation and channel meandering created environmental conditions such as water table depth and inundation frequency that were favorable to the survival of diverse native riparian communities.

Throughout the 20th Century, the rate of groundwater pumping to support agricultural development and urban settlement exceeded the rate of natural recharge. Today only a few vestiges of riparian islands remain. The Rillito River now flows only in response to storm water events and much of the channel is incised and confined by soil cement.

Current vegetation communities within the El Rio Antiguo study area are limited but include Sonoran desert scrub, mesquite bosque, Sonoran deciduous riparian scrubland, and Sonoran interior strand. Species include foothill paloverde (*Cercidium microphyllum*), velvet mesquite (*Prosopis velutina*), creosote bush (*Larrea tridentata*), saguaro (*Carnegeia gigantea*), cholla (*Opuntia* spp.), desert broom (*Baccharis sarothroides*), vine mesquite (*Panicum obrosum*), saltbush (*Atriplex* spp.), desert hackberry (*Celtis pallida*), desert willow (*Chilopsis linearis*), Bermuda grass (*Cynodon dactylon*), burrobrush (*Hymenoclea monogyra*), salt cedar (*Tamarix* spp.), Fremont cottonwood (*Populus fremontii*), Gooding's willow (*Salix goodingii*), cocklebur (*Xanthium strumarium*), and rabbit's foot grass (*Polypogon monspeliensis*).

Native wildlife species found in the project area likely include coyote (*Canis latrans*), kangaroo rats (*Dipodomys* spp.), black-tailed jackrabbit (*Lepus californicus*), cottontail (*Sylvilagus audubonii*), pocket mice (*Perognathus* spp.), ground squirrels (*Ammospermophilus spp.*), black-chinned sparrow (*Amphispiza bilineta*), roadrunner (*Geococcyx californianus*), Gambel's quail (*Lophortyx californicus*), Harris' hawk (*Parabuteo unicinctus*), curve-billed thrasher (*Toxostoma curvirostre*), Gila woodpecker (*Melanerpes uropygialis*), cactus wren (*Campylorhynchus brunneicapillus*), common raven (*Corvus corax*), canyon towhee (*Pipilo fuscus*), mourning dove (*Zenaida macroura*), whiptails (*Cnemidophorus* spp.), rattlesnakes (*Crotalus* spp.), horned lizards (*Phrynosoma* spp.), and lizards (*Urosaurus* spp.).

We are unaware of any surveys conducted to document the presence or absence of federally threatened or endangered species within the project area. Vegetation communities such as mixed shrub-cacti and mesquite could potentially be suitable for the endangered cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*).

ALTERNATIVES

The El Rio Antiguo feasibility study process involved successive iterations of alternative solutions to the defined ecosystem degradation problem. Those solutions were based upon the study objectives and designed to address opportunities while remaining within the limitations imposed by recognized constraints. Plans were analyzed using a functional assessment method developed from the Hydrogeomorphic Approach to wetland assessment. This methodology strives to model the functional components of a wetland ecosystem by identifying and quantifying criteria (i.e. geomorphic setting, water source, and hydrodynamics) that influence those functions. The following is the final array of alternatives determined by incremental cost analysis. For a more detailed description of the final array of alternatives, including maps and figures, we refer the reader to the AFB Report and Draft EIS.

No Action Alternative: Under this alternative, the Corps of Engineers would take no action to provide ecosystem restoration within the study area, nor to develop plans with potential incidental benefits associated with flood damage reduction, recreation, and water quality and supply.

Alternative 2H: This is the Corps' recommended plan and would focus on construction of one set of terraces in the river bend area (between Dodge and Country Club Roads), a low/high flow watercourse, and eight basins (all upstream of Dodge Road) designed to harvest stormwater. In addition, 12 gabions would be constructed in the river channel to facilitate vegetative growth. Plant community restoration would include development of new and enhancement of existing cottonwood-willow forest, mesquite bosque, scrubshrub association, and riverbottom systems. Plantings would be irrigated. Development would include 150 acres of mesquite bosque, 22 acres of scrubshrub, 62 acres of cottonwood/willow, and 12 acres of emergent vegetation in the riverbottom.

Alternative 2F: This alternative would focus on two sets of terraces in the bend area, a low/high flow watercourse, and eight upstream basins. In addition, 12 gabions would be constructed in the river channel. Plant community restoration would include development of new and enhancement of existing cottonwood-willow forest, mesquite bosque, scrubshrub association, and riverbottom systems. Acreage would similar to that described in alternative 2H.

Alternative 2E: This alternative is the same as Alternative 2F, except that buffer areas would be developed around restored habitats, and existing areas that serve as buffer would be enhanced with plantings.

WITHOUT PROJECT PROJECTION

In the absence of active restoration efforts, it is unlikely that significant wetland or hydro-riparian vegetation would become established within this reach of the Rillito River. Due to effects of regional groundwater pumping and channelization, it is unlikely this stretch of the Rilltio would ever exhibit the appropriate hydrogeomorphic conditions to support significant vegetation. Water would flow in the project area only in response to storm-water runoff, and retention on-site would be minimal.

WITH PROJECT PROJECTION

Implementation of the proposed project would enhance and restore native vegetation communities and wildlife habitats the Rillito River. The interagency-constructed HGM model was used to forecast annual average functional capacity units (AAFCUs) that would be provided by each of the alternatives. These numbers can be interpreted as the relative environmental outputs of each plan. AAFCUs that would be provided by each alternative are as follows: 2H, 119.66; 2F, 123.07; and 2E, 124.61.

DISCUSSION

RESPONSE

The FWS is pleased to participate in this planning process for a native riparian community restoration project in Arizona. As stated in our planning aid letter (PAL), we believe the most important aspect of riparian restoration is the attainment and proper utilization of a secure water source to ensure adequate hydrologic conditions to support the desired biotic communities. We support the utilization of reclaimed water and harvested stormwater in these efforts.

Also, as previously stated in our PAL, we believe that prior to active restoration, assessments should be conducted to ensure that chosen sites would be suitable environments for the establishment, regeneration, and survival of native riparian plants. Although irrigation would be available, we continue to support efforts to locate vegetation in sites where groundwater conditions may eventually allow plants to sustain themselves. We believe the planning process is adequately evaluating and pursuing this approach.

In addition to implementing strategies to improve the potential success of restored habitats, the Corps should proceed with restoration in a manner that minimizes or eliminates potential adverse effects on existing biological resources, particularly listed species. Although surveys have not been conducted to document the presence or absence of the cactus ferruginous pygmy-owl, the project area is within the current range of the species and potentially suitable habitat does exist within and near the project area. In the absence of survey information, the FWS suggests that elements of pygmy-owl habitat (i.e. suitable nesting trees and cacti) not be removed and construction activities occur outside of the breeding season (February 1-July 31).

This proposal could benefit from the inclusion of conservation measures, including annual surveys and habitat assessments, intended to track and evaluate the long term status of threatened and endangered species and their habitats in the study area. We encourage the local non-Federal sponsor(s) to initiate discussions with the FWS regarding the potential development of a project-level Safe Harbor Agreement for future operation and maintenance activities that may affect listed species or their habitats. Such an effort could greatly facilitate operation and maintenance of the project while providing conservation benefits to listed species.

Finally, in regard to the HGM model, although we support the process and outputs generated for this project, we encourage the Corps to work with the FWS and AGFD to evaluate the potential to simplify the HGM methodology for future projects within Arizona.

RECOMMENDATIONS

1) Continue efforts to secure effluent and storm water to support the desired biotic communities.

2) Continue to evaluate site-specific conditions to ensure appropriate establishment and growth of native riparian plants.

RESPONSE

3) Avoid the removal or modification of elements of suitable pygmy-owl habitat unless surveys show the project area to be unoccupied by the species.

4) Encourage the local sponsor to coordinate with the FWS regarding development of conservation measures that would minimize effects on listed species of future operation and maintenance activities.

5) Work with the the FWS and AGFD on a programmatic basis to simplify the HGM methodology for future restoration within the State of Arizona.

We appreciate the opportunity to provide planning assistance for this proposed project. If we can be of further assistance or you have questions, please contact Mike Martinez (x224).

Sincerely,

Steven L. Spangle
Field Supervisor

cc: Supervisor, Project Evaluation Program, Arizona Game and Fish Department, Phoenix, AZ
Kathleen Bergmann, Planning Branch, Army Corps of Engineers, Phoenix, AZ

W:/MikeMartinez/AntiguoReport.wpd:cgg

THE STATE OF ARIZONA
GAME AND FISH DEPARTMENT
2221 WEST GREENWAY ROAD, PHOENIX, AZ 85023-4399
(602) 942-3000 • AZGFD.COM

GOVERNOR
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DIRECTOR
DUANE L. SHROUFE
DEPUTY DIRECTOR
STEVE K. FERRELL

February 4, 2004

Mr. John Moeur, CESPL-PD-RP
U.S. Army Corps of Engineers
Los Angeles District
P.O. Box 532711
Los Angeles, CA 90053-2325

Re: Draft Environmental Impact Statement (DEIS), El Rio Antiguo Feasibility Study, November 2003

Dear Mr. Moeur:

The Arizona Game and Fish Department (Department) reviewed the El Rio Antiguo Feasibility Study Draft Environmental Impact Statement (DEIS), dated November 2003, for ecosystem restoration on the Rillito River. We provide the following comments for your consideration.

The Department has been involved in the planning and associated habitat analysis for this project for several years and the Department is supportive of efforts to restore native habitats along the Rillito River. In the DEIS, we note that monitoring is discussed on pages VI –18 through 20. In order to determine the effectiveness of the proposed restoration, we believe pre-construction surveys will be important to establish baseline. The plant assemblage planned is discussed on page VI-8 and includes sycamore and walnut. We suggest that the appropriateness of these species at the project elevation be verified to ensure that planted species are successful.

The Department anticipates working closely with the local sponsor and the Corps on this project as it proceeds. Please contact Ms. Laurie Averill-Murray, Tucson Habitat Specialist, at (520) 628-5376 if you have any questions regarding this letter.

Sincerely,

Bob Broscheid
Acting Habitat Branch Chief

BB:ww

cc: Laurie Averill-Murray, Habitat Specialist, Tucson

AN EQUAL OPPORTUNITY REASONABLE ACCOMMODATIONS AGENCY

RESPONSE

Comment noted. Please refer to the response to the USFWS comment (Steven L. Spangle).

UNIVERSITY OF CALIFORNIA, RIVERSIDE

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DEPARTMENT OF BIOLOGY
RIVERSIDE, CALIFORNIA 92521 USA
VOICE: (909) 787-5903
FAX: (909) 787-4286

January 26, 2004

Ms. Kathleen Bergmann
Study Manager, Plan Formulation Branch
U. S. Army Corps of Engineers
3636 N. Central Ave., Suite 900
Phoenix AZ 85012-1939

Dear Ms. Bergmann,

This is a brief response to the Norice of the proposed plan for ecosystem restoration of the Rillito River in Pima County. We are unable to attend the public meeting in Tucson on January 28.

We applaud this plan and believe that it is well worth pursuing. In the brief written description, however, we saw no mention of how invasive species might be managed.

We assume that management of non-native invasive plants is part of the complete Plan, but if not, we urge you to consider this issue fully. Invasion by tamarisk (*Tamarix* species) is one immediate example that should be of concern, because of the affinity of these plants for riparian areas, their success at excluding native plants from such areas, and the difficulty of their control.

Sincerely,

Nickolas M. Waser + Mary V Price

Nickolas M. Waser, Ph.D. and Mary V. Price, Ph.D.
Professors of Biology

RESPONSE

Management of non-invasive plants will be addressed as a focal component of the restoration effort. This is accomplished during the Pre-construction Engineering Design segment of the Plans and Specification phase of the project, once Congress gives authorization to proceed.

COUNTY ADMINISTRATOR'S OFFICE

ARCHAEOLOGY & HISTORIC PRESERVATION
201 NORTH STONE AVENUE, 7TH FLOOR
TUCSON, ARIZONA 85701-1207
(520) 740-6598 FAX (520) 740-6320

February 4, 2004

U.S. Army Corps of Engineers, Los Angeles District
John Moeur, CESPL-PD-RP
P.O. Box 532711
Los Angeles, CA 90053-2325

Re: Rillito River, Pima County, Arizona, El Rio Antiguo Draft Feasibility Study, October 2003

Dear John:

I have reviewed the Rio Antiguo draft feasibility study. This is a comprehensive report. I have only a few comments.

Figure 2.4. The University of Arizona parcel (formerly known as Christopher City, which is adjacent to Columbus Blvd) is now private land. The parcel shaded a blue-green color (a color that seems not to be in the key) that is located just south of Fort Lowell Road and Christopher City is also private. These are now both residential subdivisions: Christopher City is called Riverhaven, and the parcel south of Ft. Lowell Rd. is called Barrio Centro. The figure should be corrected. These landownership issues may also change some of the acreage figures in the study.

Chapter III. B. Other agency reports should include the cultural resources overview conducted for the Rio Antiguo project. This is: "Little River: An Overview of Cultural Resources for the Rio Antiguo Feasibility Study, Pima County, Arizona" by Scott O'Mack, Scott Thompson, and Eric Eugene Klucas, 2003, Statistical Research Inc., Technical Report 02-03.

In addition the National Register Nomination form for Binghamton, in the Bend area, should be included in the other agency reports section. The reference is: National Register of Historic Places, Binghampton Rural Historic Landscape, 2001, Janet H. Parkhurst preparer, Pima County Cultural Resources Office.

Page IV-42, Cultural. The Binghamton Rural Historic Landscape, which is within site AZ BB:9:238, was listed in the National Register of Historic Places on May 1, 2003. Please restate the status of this historic property. The National Register listed area should be

RESPONSE

Thank you for the comments. The figure is based on the most current ownership information available at the time. The text of the Feasibility Study has been revised to clarify ownership concerns.

depicted on relevant figures in this study. Please also note, here and elsewhere in the study, that Finger Rock Wash flows through this National Register listed area.

Page IV-47, second line. It may be advisable to replace Maricopa County with Pima County.

Pages VII 3 through 5. We agree with the approach provided here. A Memorandum of Agreement is certainly the best way to detail the implementation of cultural resources requirements for the proposed project. Again, it should be noted in this section that the Binghamton Rural Historic Landscape, which is within site AZ BB:9:238, was listed in the National Register of Historic Places on May 1, 2003.

The staff of the Pima County Cultural Resources and Historic Preservation Offices looks forward to continuing work with the Army Corps of Engineers on this important environmental project, while preserving our significant cultural resources.

Thank you for the opportunity to review this study.

Sincerely,

Roger Anyon
Cultural Resources Coordinator.

cc. Carla Danforth, PC FCD

CITY OF TUCSON
TUCSON WATER DEPARTMENT

February 10, 2004

Ms. Kathleen M. Bergmann
U.S. Army Corps of Engineers
3636 N. Central Avenue, Suite 900
Phoenix, AZ 85012-1939

Subject: City of Tucson Comment on "Rillito River, Pima County, Arizona El Rio Antiguo" Final Draft Feasibility Study Report

Dear Ms. Bergmann:

Tucson Water staff appreciates your transmittal of the above noted draft environmental restoration feasibility study provided for review. Staff is impressed with the effort taken to use naturally available water to the maximum extent possible as well as reclaimed water. It shows a pragmatic, forward looking strategy that recognizes those water resources will become increasingly limited in the years to come. Under this overall approach, the increasing water supply needs of municipal providers will not be in conflict with efforts to restore habitat along the riparian corridors.

There is one area where this recognition of limited resource has been overlooked. In Chapter 5 (Plan Formulation) and on page V-17 in the second paragraph, there is a discussion on the amount of effluent discharged to the Santa Cruz River by the Roger Road Wastewater Treatment Plant (RRWTP) and Ina Road Water Pollution Control Facility (IRWPCF). The second sentence in the paragraph states that "[m]ost of this effluent is unallocated." All of the effluent currently being discharged by the two treatment plants and which recharges the aquifer between the Roger Road outfall and Trico Road is under the ownership and control of multiple parties pursuant to two managed underground storage facility permits and associated water storage permits issued by the Arizona Department of Water Resources.

The southernmost of the two is called the Santa Cruz River Managed Underground Storage Facility (Permit No. 71-545944) which begins at the outfall of the RRWTP and ends 5.1 miles downstream at Ina Road. The City of Tucson and the U.S. Bureau of Reclamation are the parties associated with this managed in-channel recharge facility. The second facility which lies immediately to the north is called the Lower Santa Cruz Managed Recharge Project (Permit No. 71-591928) which begins at Ina Road and continues about 17.9 miles downstream to Trico Road. The parties associated with the latter facility permit include the City of Tucson, the Town of Oro Valley, the Town of Marana, the Metropolitan Domestic Water Improvement District, the Cortaro-Marana Irrigation District and Cortaro Water User's Association, the Avra Valley Irrigation Drainage District, the Flowing Wells Irrigation District, and Pima County Wastewater Management. It is possible that the U.S. Bureau of Reclamation will also elect to accrue storage credits at this facility in the future.

The bottom line is that the effluent which is currently being recharged within the domains of the two underground storage facility permits is unavailable for other uses unless purchase or lease is made with one or more of the parties who are (or will be) accruing credits. Any reference in the draft feasibility study to the availability of municipal effluent for potential use in a riparian enhancement project in the Tucson area

TUCSON WATER
RESEARCH AND TECHNICAL SUPPORT • P.O. BOX 27210 • TUCSON, AZ 85726-7210
(520) 791-2689 • FAX (520) 791-3293 • TTY (520) 791-2639 • www.cityoftucson.org

RESPONSE

Comment noted. Reference to the effluent as unallocated water has been deleted from the report.

RESPONSE

should take this into account. This was recognized in the ongoing Tres Rios del Norte study and the same should be noted in this and any other restoration project which views municipal effluent as a potential supply source.

If Army Corps staff has any questions or comments regarding the above, please have them give me a call at (520) 791-2689 or they can send me an email at Ldmith1@mail.ci.tucson.az.us.

Sincerely,

Linda Smith

Linda Smith
Principal Planner

LS:RioAntiguoComment_TW021004.doc

cc: Marie Pearthree
Joe Babcock
Ralph Marra
Karen LaMartina
Ries Lindley
Carla Danforth (PCFCD)
Hydrology File

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers.

Name Charlotte Adams

Address 4348 E. Samantha City Tucson State AZ Zip 85712

Daytime Telephone 3266770 Evening Telephone same

Association/Organization homeowner, off Greenlee at Columbus

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other _____

COMMENTS

At the end of Columbus Blvd. at Greenlee, on the N.E. corner these is a large lot. We are told that it was a landfill. Could materials leach into the Rillito River? Are any considerations being made, or is this not a concern. Thank you!

Thank you for providing us with this information. Please mail or fax your comments to:

Community Relations Office
Pima County Department of Transportation
201 North Stone Avenue, 3rd Floor
Tucson, Arizona 85701
Phone: 740-6410 FAX: 740-6439

RESPONSE

The study area boundary is illustrated in Figure 2.2 and Figure 4.7 of the Feasibility Study. The Columbus landfill referred to in your comment is outside of the project area. The following has been determined through the project study:

- To assess risk to a restoration project, site assessments including soil and groundwater sampling and some trenching into the debris in order to examine them would be in order. All have been undertaken regarding the Columbus landfill, determining that there was no groundwater contamination or strong evidence of landfill leachate. In addition, there was no evidence of methane production, TPH (total petroleum hydrocarbons), or other hazardous waste above regulatory levels, although there was evidence of asbestos containing materials in the landfill and spilled fuel on the surface.

The Columbus landfill is discussed in the Geotechnical Appendix F of the Feasibility Report, Chapter IV, B. Existing Conditions, Water Quality, Landfills; and Chapter 4.12 of the EIS.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name Scott Beck

Address 4275 E Sapphire Falls City Tucson State AZ Zip 85712

Daytime Telephone 615-9191 Evening Telephone _____

Association/Organization _____

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other _____

COMMENTS

The area of the Rillito near Columbus is one of the last natural areas. Consider not alter this area in a way to reduce natural setting.
I.E.– no concrete bank protection near Columbus.
no parking areas near Columbus (existing parking @ Swan, use future Alvernon).
no pedestrian bridge @ Columbus for visual impact reasons. Bridges @ Swan, Alvernon.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for your comment.

El Rio Antiguo Ecosystem Restoration Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers

Name Barbara M. Cain

Address 3489 N. Cmo. La Ticarrilla City Tucson State AZ Zip 85712

Daytime Telephone (520) 881-5689 Evening Telephone

Association/Organization Hacienda Del Rio Homeowners Assoc

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other

COMMENTS

I walk each morning in the Craycroft - Dodge Reach area. I look forward to the riparian restoration project and the Summit Lands project / Swan greenlawns. I do hope you can solve the mosquito problem!

I am asking that you increase the budget for more County Park Rangers to protect property & citizens who live near the park area.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Comment noted. The project includes a park person for general patrols, surveys, and biological tasks associated with operation and maintenance activities.

El Rio Antiguo Ecosystem Restoration Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name Allyson Carter

Address 4472 E. Haven Lane City Tucson State AZ Zip 85712

Daytime Telephone _____ Evening Telephone _____

Association/Organization Creekside

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other _____

COMMENTS

Please send any handouts from the talk as I arrived late to meeting.

Thank you for providing us with this information. Please mail or fax your comments to:

Community Relations Office
Pima County Department of Transportation
201 North Stone Avenue, 3rd Floor
Tucson, Arizona 85701
Phone: 740-6410 FAX: 740-6439

RESPONSE

Comment noted. Name added to mailing list.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers.

Name Steve and Kristin Coleman

Address 3401 E. River Rd City Tucson State AZ Zip 85718

Daytime Telephone 520/299-8101 Evening Telephone Same

Association/Organization Binghampton Rural Historic Landscape

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other _____

COMMENTS

Please send us the stapled handout that was distributed at the meeting in Tucson on Wed., Jan. 28.

Mailed 2-19-04

We need to know when the engineering plans are drawn up.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

The handout was mailed 2-19-04.

Engineering plans will be drawn up during the design phase of the project. The public will be informed of the plans through the public involvement process. Your name has been added to the mailing list.

El Rio Antiguo Ecosystem Restoration Feasibility Study
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Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name Spencer Davis

Address 4222 E Megan Dr City Tucson State Az Zip 85712

Daytime Telephone 795-8543 Evening Telephone _____

Association/Organization —

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other _____

COMMENTS

This meeting was very informative about what is going to happen on the Rillito and surrounding areas. I live near the river area and use the multi use trail often. Having the river park and redevelopment plan will be a big plus to the area value wise

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for your comment.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers.

Name Richard Grubbs

Address 841 E Trenton Place City Tucson State AZ Zip 85737

Daytime Telephone (520) 877-8231 Evening Telephone same

Association/Organization Concerned property owner

How did you hear about the public meeting?
- [x] Received Mailing
- [ ] Advertisement
- [ ] Other _____

COMMENTS

See Figure 5-1 Alternative 2H (N part of Country Club Rd not shown on illustration, why?)

N. Country Club Rd continues N for almost another mile from E Prince Rd. That section of Country Club Road is built up almost solid with Condominium Associations between Country Club Rd and the cement wall of the West side of the river. Their buildings and walls extend to the rivers edge. Figure 5-1 shows a maintenance road thru that area. It seems to me that these illustrations are an attempt to minimize opposition to the special interest groups pushing this discretionary spending.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

The north part of Country Club Road is not shown because the map layer used did not include it.

The Alternative maps are conceptual. The precise trail locations will be determined during final design and construction. The final trails and linkages will not infringe on the property rights of condominium properties.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers.

Name EARL W. JERNIGAN

Address 2532 N. COLUMBUS City TUCSON State AZ Zip 85712

Daytime Telephone 520-881-5069 Evening Telephone SAME

Association/Organization RETIRED

How did you hear about the public meeting?
- ☐ Received Mailing
- ☐ Advertisement
- ☑ Other MARCUS JERNIGAN

EL RIO ANTIGUO • RILLITO RIVER

COMMENTS

I STRONGLY SUPPORT THE EFFORT TO ENHANCE THE BIOME OF THE RILLITO. I WALK THERE EVERY DAY AND ENJOY THE NATURAL SETTING. I HAVE EVEN HELPED TO CLEAN THE RIVER BED UP. I WISH THE LAWS ON LOOSE DOGS WERE BETTER ENFORCED. THERE ARE MANY ALONG THE RIVER EVERY DAY.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for your comment. Please consult with the City of Tucson and Pima County concerning dog ordinances.

03/11/04 THU 13:58 FAX 213 452 4219 Environmental Res Br 013

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers

Name Marcus Jernigan

Address 4262 N. Limberlost Pl. City Tucson State AZ Zip 85705

Daytime Telephone (520) 886-7956 Evening Telephone Same

Association/Organization

How did you hear about the public meeting?
- [x] Received Mailing
- [ ] Advertisement
- [ ] Other

EL RIO ANTIGUO • RILLITO RIVER

COMMENTS

As a member of the El Rio Antiguo Citizens' Work Group during the year 2002 I compiled a list of plant species that I believed would be appropriate for restoration along the Rillito. In 2003 I added my rationale for selecting the species in the list and adapted it for the Swan Wetlands project. I have enclosed a copy of this revised list to expand upon what I provided for the El Rio Antiguo Citizens' Work Group Plan, given the fact that I feel that all species included could be suitable for both projects.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for the plant list. Your extensive efforts are appreciated. It will be included during the Pre-construction Engineering Design segment of the Plans and Specification phase of the project, once Congress gives authorization to proceed.

RESPONSE

As a native of Tucson who has considerable experience with and love of the natural vegetation of the area, I have compiled a list of native plant species that I feel would be appropriate for cultivation in the Swan Wetlands Project. Each species (or pair of species) is followed by a brief description that summarizes why I think it (they) would be suitable for the project. Local distributions provided in each summary are based mainly on my personal observations. Some of the more general distribution patterns given, as well as certain other species characteristics, were taken from one or more of the following references:

- Arizona Flora, Kearney and Peebles, 1951
- Woody Plants of the Southwest, Lamb, 1975
- Shrubs and Trees of the Southwest Uplands, Elmore, 1976

I did not include grasses, sedges, rushes nor ferns in this list because my knowledge of these plant groups is limited. I also did not include native plant species that I believe would effectively colonize the project site on their own (i.e. Hymenoclea monogyra, Baccharis sarothroides, etc.).

RESPONSE

A biological reference site for the related El Rio Antiguo Project has been established where Tanque Verde Creek and Agua Caliente Wash converge. My inclusion of a number of plant species in this list is based on their presence in or near this reference site.

I attended the April 17th Public Meeting on the Swan Wetlands Project and was pleased to hear about proposed plans to eradicate tamarisk from the project site, given its tendency to choke out native riparian vegetation.

Marcus Jernigan
5/22/03

RESPONSE

Native Plants that I would like to see Cultivated in the Swan Wetlands Project

Plants for Riparian Areas

Populus fremontii subsp. fremontii, Fremont Cottonwood and Salix gooddingii, Goodding Willow: These two tree species were almost certainly the dominant riparian overstory plants along the upper Rillito in historical times. I would like to see the preservation of cottonwoods and willows that are presently growing in the western portion of the project area. My hope is that these trees will be irrigated as soon as possible, given the fact that many of them are succumbing to drought conditions.

Fraxinus velutina, Velvet Ash and Juglans major, Arizona Walnut: These two tree species are common where Tanque Verde Creek and Agua Caliente Wash converge (an area that is relatively undisturbed) and were probably quite common along the upper Rillito in historical times.

Celtis reticulata, Netleaf Hackberry: Historically, this tree was very common along irrigation ditches in the vicinity of the Swan Wetlands Project. Relic stands of this species still exist along sections of these ditches, despite

RESPONSE

Plants for Riparian Areas (cont.)
the fact that they no longer carry irrigation water. Celtis reticulata is also quite common in certain undisturbed areas along Tanque Verde Creek (i.e. near Houghton Road). A related species, Celtis pallida, is better suited to rocky foothill washes than the valley bottom floodplain along the south bank of the Rillito.

Sapindus saponaria var. drummondii, Western Soapberry: This tree occurs sporadically along Tanque Verde Creek and probably grew here and there along the upper Rillito.

Platanus wrightii, Arizona Sycamore: This tree is common along the portion of Sabino Creek that is down in the Tucson Basin. Although I saw a small Platanus wrightii tree growing in the Rillito near the north end of Columbus Blvd. (not long before the soil cement was installed in this area), I think that this species prefers stream beds that contain a greater number of sizable rocks than occur in the Rillito.

Sambucus nigra subsp. cerulea (Sambucus mexicana), Mexican Elderberry: This shrub or small tree was probably one of the most common riparian understory plants along the Rillito at one time. It is still found growing here and there in undisturbed areas along the upper Rillito. Sambucus berries are an important

RESPONSE

Plants for Riparian Areas (cont.)
source of food for birds.

Cephalanthus occidentalis, Buttonbush: This shrub is common along Sabino Creek near the mouth of Sabino Canyon and was probably quite common in moist areas along the Rillito.

Baccharis salicifolia, Seep-willow: This shrub was once probably very common along the Rillito and even today is not rare here.

Senna hirsuta (Cassia leptocarpa): This large herb is found in sandy creek beds such as that of the Tanque Verde near its confluence with Agua Caliente Wash. Its striking yellow flowers were probably a rather common sight along the Rillito in historical times.

Plants for Floodplain Areas

Prosopis velutina, Velvet Mesquite: This species is the most common tree in undisturbed floodplain areas along the Rillito. This is the only native mesquite species that I have found growing wild in the general area of the Rillito. Like many other leguminous plants, its roots fix nitrogen and the plant ends up fertilizing surrounding soil.

RESPONSE

Plants for Floodplain Areas (cont.)

Chilopsis linearis, Desertwillow: This tree is generally found in sandy washes and floodplains that are free of surface water for most of the year. It is common in the floodplains of the Rillito.

Acacia greggii, Catclaw Acacia: This species often occurs as a shrub, but can grow into a tree when conditions are favorable. It often grows with Prosopis velutina and is also common in floodplains of the Rillito.

Cercidium floridum, Blue Paloverde: This tree species is frequently found in floodplains of the Rillito and is particularly common along tributary washes.

Ziziphus obtusifolia, Graythorn: This shrub is generally found growing with Prosopis velutina and is common in undisturbed floodplains along the Rillito. Its proliferation of large thorns provides a good nesting site for certain bird species.

Atriplex canescens, Four-wing Saltbush: This shrub species is quite commonly found growing in open areas of floodplains along the Rillito. The related Atriplex lentiformis may not actually be native to the Rillito area, although it is common in western Arizona.

RESPONSE

Plants for Floodplain Areas (cont.)

Lycium andersonii, Anderson Lycium: This shrub is often found growing near Prosopis velutina and is probably the most common Lycium species in the area of the Upper Rillito.

Condalia warnockii, Warnock Condalia: This shrub is found here and there along floodplains of Tanque Verde Creek in the area of its confluence with Agua Caliente Wash.

Cylindropuntia leptocaulis, Christmas Cholla: This cactus is common in floodplain areas of the Tucson Basin and probably grew in some areas of the southern floodplain of the upper Rillito in historical times.

Clematis drummondii: This woody vine is quite common in floodplains of Tanque Verde Creek and still occurs in some locations along the Rillito.

Sarcostemma cynanchoides, Climbing Milkweed: This somewhat woody perennial vine is frequently found growing on trees and shrubs of floodplains in the Tucson Basin. Like many milkweed species, its flowers attract butterflies.

Ipomoea hederacea (Ipomoea hirsutula), Desert Morning-glory: This summer annual vine is common in mesquite bosques including some along the Rillito.

RESPONSE

Plants for Floodplain Areas (cont.)

Ruellia nudiflora and Rhyncosida physocalyx: These two perennial herb species are frequently found growing in the shade of Prosopis velutina in the Tucson Basin including undisturbed bosques near the Rillito.

Aristolochia watsoni, Indian Root: This perennial herb is somewhat common in Prosopis velutina bosques of the Tucson Basin.

Rumex hymenosepalus, Cañaigre: This perennial herb is common in open, sandy areas of the Rillito floodplains.

Cucurbita digitata, Finger-leaf Gourd: This herbaceous trailing perennial is somewhat common in floodplains of the Tucson Basin including those of the Rillito.

Nicotiana obtusifolia (Nicotiana trigonophylla), Desert Tobacco: This herb can be annual or perennial and is common in floodplains of the Rillito.

Proboscidea parviflora, Purple-flowered Devil's-claw: This herbaceous summer annual is somewhat common in floodplains of the Tucson Basin including those of the Rillito.

Euphorbia heterophylla, Painted Spurge: This herbaceous summer annual is quite common

RESPONSE

Plants for Floodplain Areas (cont.)
In floodplains of the Tucson Basin:

Kallstroemia grandiflora, Arizona Caltrop:
This herbaceous summer annual is common in floodplains of the Tucson Basin when rains are plentiful. It has showy orange flowers.

El Rio Antiguo Ecosystem Restoration Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name V. C. KARUMANCHI

Address 4750 E. CALLE CHOECA City TSN State AZ Zip 85718

Daytime Telephone 577-0560 Evening Telephone 577-0550

Association/Organization

How did you hear about the public meeting?
- [x] Received Mailing
- [ ] Advertisement
- [ ] Other

COMMENTS

Please send me the plans.

Thank you for providing us with this information. Please mail or fax your comments to:

Community Relations Office
Pima County Department of Transportation
201 North Stone Avenue, 3rd Floor
Tucson, Arizona 85701
Phone: 740-6410 FAX: 740-6439

RESPONSE

Comment noted. Your name has been added to the mailing list.

El Rio Antiguo Ecosystem Restoration Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers.

Name Charles H. Matthewson, Environmental Planning Director
Address Pima Association of Governments, 177 N. Church Ave., Suite 405 City Tucson State AZ Zip 85701
Daytime Telephone 520-792-1093 ext. 448 Evening Telephone 520-529-7316
Association/Organization Canal of Governments/Metropolitan Planning Org.

How did you hear about the public meeting?
- ☐ Received Mailing
- ☐ Advertisement
- ☒ Other word of mouth

EL RIO ANTIGUO · RILLITO RIVER

COMMENTS

Please add me to any + every mailing list used for projects worked by the Corps in eastern Pima County. I have watershed + air quality planning responsibility for the metropolitan Tucson region. Thank you.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for your comment. Your name has been added to the mailing list. Thank you for the information related to your Pima County Association of Governments' responsibilities with air quality planning.

El Rio Antiguo Ecosystem Restoration Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name CLIFFORD B. MAY

Address 3325 N. Sagewood Dr. City Tucson State AZ Zip 85712

Daytime Telephone (520) 322-6775 Evening Telephone —

Association/Organization Town & Country I Neighborhood Association

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other _____

COMMENTS

The presentation was excellent and gave the impression that this project would be an invaluable addition to our community. I have no reservations about the proposal as presented.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you, comment noted.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name Marianne McFance

Address 3380 E Riverside City Tucson State AZ Zip 85718

Daytime Telephone 577-6643 Evening Telephone same

Association/Organization

How did you hear about the public meeting?
- ☒ Received Mailing
- ☐ Advertisement
- ☐ Other

EL RIO ANTIGUO • RILLITO RIVER

COMMENTS

Will the water harvesting basins & furrowing affect the amount of water available to private wells along the sides of River Road between Campbell & Alvernon way? There is no city water there, so natural run off is essential to our wells. We could drink reclaimed water.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

A principal constraint on any restoration project is the limited availability of water to support establishment and maintenance of healthy riparian habitats. Both reclaimed effluent water and surface water represent potential water sources. However, given the variability of seasonal or monthly flows, the actual surface water available in any given month can vary from zero to volumes in excess of what could be harvested. Due to this variability, irrigation systems for this restoration project have been designed with enough flexibility to meet the needs of the vegetation.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers®

Name Susan Newman Univ. Farms Neighborhd

Address 4310 N Mainard City Tuc State Zip 85719

Daytime Telephone 321-0286 Evening Telephone

Association/Organization

How did you hear about the public meeting?
- ☐ Received Mailing
- ☐ Advertisement
- ☒ Other River Rd / Alvernon expansion open House

EL RIO ANTIGUO • RILLITO RIVER

COMMENTS

Removal of Concrete & Rebar in River
You've created Equestrian Trails on top
but most of us ride in the river
The hazards in the form of rebar
poking up thru the sand an enormous -
worst between Campbell & 1st
If you're inviting riders into Riverbend Pk
& into the river, they'll never know the
serious hazards are there.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

I applaud your riparian intent for the Rillito & thank you for finally handling the storm drain @ Campbell

RESPONSE

Comment noted. The local non-federal sponsor, Pima County, is aware of the concern.

03/11/04 THU 13:58 FAX 213 452 4219 Environmental Res Br 012

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers

Name Karen Nickey

Address 4407 E. Orchard Dr. City Tucson State AZ Zip 85712

Daytime Telephone (520) 791-4857 Evening Telephone (520) 326-2070

Association/Organization

How did you hear about the public meeting?
- ☑ Received Mailing
- ☐ Advertisement
- ☐ Other

COMMENTS

I'm very pleased with the overall plans, especially that a variety of habitat types are included. I hope the funding for the project comes through & work begins soon. I'm wondering who is in charge of the pond & marsh area planned for the south side of the Rillito R. just to the east of the end of Columbus. It is supposed to be separate from Rio Antiguo.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

The project referred to in the comment is known as the Rillito River Riparian (Swan Wetland) project. It is a separate project due to the category and manner of the federal funding process. Please note that the Rillito River Riparian (Swan Wetland) project no longer has an open water freshwater marsh habitat component due to the health and safety concern of freshwater mosquitoes.

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers.

Name Don Schroeder

Address 3475 N. Craft City Port Tucson State AZ Zip 85718

Daytime Telephone 299-4276 Evening Telephone —

Association/Organization

How did you hear about the public meeting?
- [x] Received Mailing
- [ ] Advertisement
- [ ] Other

COMMENTS

Me information about whether or not you will be taking any of my property — I adjoin the county property on the north bank of the Rillito at Craycroft.

— Where Craycroft Rd is being expand, How will that affect drainage — Please contact me.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for the comment. The property referred to in the comment is not part of the restoration project. The yellow study boundary line represents a general boundary that is intended to be illustrative. During the Pre-construction Engineering Design segment of the Plans and Specification phase of the project, once Congress gives authorization to proceed, there will be a more precise determination of project boundary lines.

5132 East Fort Lowell Road
Tucson, Arizona 85712
February 6, 2004

Ms. Kathleen Bergmann
U. S. Army Corps of Engineers
3636 North Central Ave, Ste. 900
Phoenix, AZ 85012-1939

Dear ms. Bergmann:

I am an ecologist who formerly worked for the U.S. Geological Survey in Tucson until my retirement in 1989. I have had a long-term interest in changes in vegetation of our region and was quite taken by the note in your "Notice of Public Review . . ." presented at your Jan. 28, 2004 meeting here in Tucson, to the effect that "Historical accounts of conditions on the Rillito approximately 100 years ago describe a tree-lined, narrow river with dense vegetation winding throughout the riverbed and vicinity." I have spent many years studying changes along the watercourses of our region and have yet to find historical accounts that support this view of the region's riparian vegetation.

I call to your attention the following:

Robert Zimmermann, 1969, Plant Ecology of an Arid Basin: Tres Alamos-Redington Area, Southeastern Arizona. U.S. Geological Survey Professional Paper 485-D. See p. D44 for a description of the vegetation along the Rillito in the 1960s.

Eva L. Willis, 1939, Plant associations of the Rillito floodplain in Pima County, Arizona. Masters Thesis, University of Arizona Library.

Raymond M. Turner, 2003, Pima County's Withdrawal from Its Past. Sonoran Desert Conservation Plan, Pima County, Arizona. See especially pages 24 to 33 for a discussion of historical changes along the region's streams. (This publication can be found on the web at Pima County-> Sonoran Desert Conservation Plan-> Reports -> Pima County's Withdrawal from Its Past.)

Raymond M. Turner, Robert H. Webb, Janice E. Bowers, 2003, The Changing Mile Revisited. University of Arizona Press. 334 pages. See especially pages 261-262, but also Plate 7 and Plates 42-46.

I have spent many hours searching the literature for statements or photographs that support the scenario that water flowed perennially along the El Rio Antiguo reaches of the Rillito. I would especially like to receive references to the "Historical accounts of conditions on the Rillito approximately 100 years ago (which) describe a tree-lined, narrow river with dense

RESPONSE

Thank you for your comment as well as taking the time to research the historical accounts of Rillito River conditions in relation to perennial water flow and riparian forest habitat. In the Pima County, Arizona, document, *Historical Occurrences of Native Fish in Pima County, Arizona*, Sonoran Desert Conservation Plan, David Scalero and Julia Fonseca, November 2000, we found the following:

> Marshy conditions most likely occurred all along the watercourses of Rillito Creek, Pantano (Spanish for "swamp") Wash and Cienega Creek3, which were collectively known in historic times as the "Cienegas de Los Pimas" (Hendrickson and Minckley, 1984). Records indicate that Rillito Creek, now only a dry river bed, was once perennial near Fort Lowell to its confluence with the Santa Cruz River (Condes de La Torre, 1970). Post Surgeon J.B. Girard painted a watercolor in 1875 that displays the wet nature of Rillito Creek in this area (Figure 3). Robert Eccleston, an early explorer, first entered the basin at Cienega Creek in 1849 and followed it 5 miles downstream (Davis, 1982). He had this to say about the area: "The water was in marshes, coming from springs and a little brackish…. The grass, or rather cans, was some 6 feet high…" (Hendrickson and Minckley, 1984). During a stagecoach trip in 1858, Way (1960) described the valley as "a delightful looking place and its cool water, green foliage and scrubby trees look like paradise to the weary traveler over the hot and parched up plain." G.E.P Smith, another early visitor to Cienega Creek described the valley as "an unbroken forest, principally of mesquite, with a good growth of gramma and other grasses between the trees. The River course was indefinite, a continuous grove of tall cottonwood, ash, willow and walnut trees with underbrush and sacaton and galleta grass, and it was further obstructed by beaver dams…" (Hendrickson and Minckley, 1984). Remnants of this once expansive system still exist today along the upper and lower reaches of Cienega Creek.

vegetation winding throughout the riverbed and vicinity." This runs counter to much that I have found in the literature. To expend large amounts of water to bring back riparian forests that used to be there, is one thing. But to establish these forests where none existed before would be folly and a waste of the scarce water resource.

I hope that these comments are of use to you as your plans are formulated and that you can respond to my request for the historical accounts referred to in your handout.

Very truly yours,

Raymond M. Turner

Raymond M. Turner
U.S. Geological Survey (Retired)

RESPONSE

Furthermore, hydrologist G.E.P. Smith states: ". . . the oldest known effort at settlement in the Rillito Valley was that of an Arkansas pioneer who cleared a small area of bottom land just east of Fort Lowell in 1858. The entire valley was at that time unbroken forest, principally of mesquite, with a good growth of grama and other grass between the trees. The river course was indefinite, a continuous growth of tall cottonwoods, ash, willow, and walnut trees with underbrush and sacaton and galleta grass, and it was further obstructed by beaver dams. . . . New and unusual flood cut out a channel, washed the big cottonwoods away, and exposed the white sand" (Smith, G.E.P. 1920. Groundwater Supply and Irrigation into the Rillito Valley, University of Arizona Experiment Station Bulletin #64, Tucson, Arizona as cited *in* Scalero, David, and Julia Fonseca. 2000. Historical Occurrence of Native Fish in Pima County, Sonoran Desert Conservation Plan, Pima County. Tucson, AZ).

Lastly, Ms. Eva L. Willis's evaluation of the area states: "From what I have read the area around Craycroft did have a shallow meandering stream, due to high groundwater, marked by a continuous grove of cottonwood, ash, willow and walnut, with sacaton, gramma and galleta grass, and beaver dams. There was an Army post that was moved there (SE of the River and Craycroft Road) in 1872. They quickly cut the hay and grazed cattle. After that, erosion downcutting and flooding began and the length of time the stream bed was dry increased. Also, a number of irrigation ditches had been dug by Mormons and others and this further decreased the period of flows." (Willis, Eva A. 1939. Plant Associations of the Rillito Floodplain in Pima County. Unpublished Master of Science Thesis, University of Arizona, Tucson, AZ).

El Rio Antiguo Ecosystem Restoration
Feasibility Study
Comment Forms
Public Meeting
January 28, 2004

US Army Corps of Engineers

Name Rebecca Weinberg

Address 4215 E. Sapphire Falls Dr City Tucson State ____ Zip 85711

Daytime Telephone ~~790-7870~~ 747-2822 Evening Telephone 790-7870

Association/Organization Homeowner

How did you hear about the public meeting?
- ☑ Received Mailing
- ☐ Advertisement
- ☐ Other read article in Az. Star

COMMENTS

Project is exciting. I support what ever we can do to restore the riparian environment. I live on the edge of the proposed riparian area at the (S) side of Columbus and would be happy to participate in any way.

Thank you for providing us with this information. Please mail your comments to one of these contacts:

Kathleen Bergmann
US Army Corps of Engineers
3636 N. Central Ave. Ste 900
Phoenix, Arizona 85012-1939

John Moeur
US Army Corps of Engineers
CESPL-PD-RN
915 Wilshire Blvd
Los Angeles, CA 90017

RESPONSE

Thank you for the comment of support.

Barbara Cain testimony

"If we're (the project) adding extra parking lots and more access, and we're bringing more people in here, is there also a plan to increase the budget for park rangers, so that once in a blue moon somebody walking up and down there to keep some of the criminal elements and people towing the line, so to speak?"

RESPONSE

Comment noted. Please see response to your written comment.

Richard Hill testimony

"I have one other question, completely different. They keep speaking about reclaimed water. And all you have to do is you can pick up a journal or magazine and once a month and you will find that the prescription drugs and the medicines that are being flushed down the toilets are not being cleaned out. The sewage treatment plant cannot handle these drugs, and there are fish problems in the Chesapeake Bay and there are problems in Switzerland and there are problems in Germany, and how are you going to protect the wildlife from this, from the reclaimed water of the prescription drugs?"

RESPONSE

Water used to irrigate restored habitat will meet all current applicable water quality standards and regulations as established by the U.S. Environmental Protection Agency and Arizona State agencies.

Marcus Jernigan testimony

"I have a question about public involvement. I know this is one example, but I guess I'm thinking of the actual planting of the native vegetation and also the maintenance. Would there be a way that public groups could get involved in, you know, that might help to decrease the maintenance costs and maybe the construction costs, as well as personally involving members of the public in the ecosystem restoration efforts?"

RESPONSE

Involvement with planting the restoration site would be coordinated through the various public groups and the non-federal local sponsor, Pima County. This coordination would take place during the next phase of the project, the Pre-construction Engineering Design segment of the Plans and Specification phase, once Congress gives authorization to proceed.

V. C. Karumanchi testimony

“. . . from the map, you know, it looks like you excluded that property from acquisition. And you included my property into the acquisition. Why is that? Why aren’t you take this property? You know the citizens? You know, up close to the county? And what did you create, you know, how are you going to compensate the people when you aren’t acquiring the land?”

RESPONSE

Comment noted. This project will not affect the property referred to in the comment.

Susan Newman testimony

"You're inviting people to ride in an area, if you get down in the river, which is still very dangerous because of the amount of cement blocks and reinforcement bars that are down in there, and every time the river flows, it surfaces in other places. And I realize with a certain amount of riding a horse over it that you've been riding over it for a while, because the river shifted when it's flowed. Is there, with all this road equipment that's going to be available to taking out bridges and putting in bridges, is anything going down into the river to remove any of the hazardous stuff? I mean you're inviting people to come to River Bend Park to ride in the river; I'm not quite sure why they would and not just go out in that one area, but if you're inviting people who don't know the river to come down into it, you're asking for someone maybe to have to come up with a shotgun and shoot a horse because of what they stepped on down in the river, and it's a hell of a liability."

RESPONSE

The local non-federal sponsor, Pima County, will address the issue of hazardous debris and rack buildup. If it is determined to be part of the restoration effort, it will be addressed during the Pre-construction Engineering Design segment of the Plans and Specification phase of the project, once Congress gives authorization to proceed.

Richard Shapiro testimony

"My concern is with the northeast-most reach of this project, where the Craycroft wash comes in. There's an equestrian facility in the Craycroft Wash. The Craycroft Wash is a designated trail, and I know there's going to be a widening of Craycroft, a realignment of River Road, and how is this all being addressed to get equestrian traffic safely from the Craycroft Wash through all of that traffic and into the Rillito?"

RESPONSE

Please refer to response to Don Schroeder written comment.

EL RIO ANTIGUO RILLITO RIVER

PIMA COUNTY, ARIZONA

FEASIBILITY STUDY and ENVIRONMENTAL IMPACT STATEMENT

January 28, 2004

Tucson, Arizona

Reported by:
James E. Bouley CCR #50003

BOULEY, SCHLESINGER and SCHIPPERS
2030 North Forbes Boulevard
Suite 103
Tucson, Arizona 85745
(520) 623-7573
1-800-687-7085

MS. SHIELDS: If you'd like to take a seat we'll start getting the meeting ready; thank you. Are we ready to start the meeting?

Can everybody hear me in the back? No, you can't? It sounds really loud up here. But now you can hear me, okay.

I want to thank you all for coming this evening to our open house. My name's Susan Shields, I'm the Deputy Director for the Pima County Flood Control District in the Department of Transportation and Flood Control District. I have several of my staff here that have been working very hard on this project from the Flood Control District.

We have Carla Danforth, we have Elizabeth, Tom Helfinch is somewhere in the back, he's our Division Manager for our Riparian Water Resources Division, Carol and Alicia are in the back giving out information.

There are speaker cards if you wish to speak, because this is a formal meeting. We actually have a court reporter so that we make sure we know what you're saying.

And there are Bill Cassario from the Parks and Recreation Department is here and Raphael Payan, Director of Pima County Parks and Recreation.

Like I say, we're very pleased to have you come here. We're even more pleased to present the information that has been pulled together. This has been a long process of two years. We do train a little bit on the core process. What this is is a feasibility report.

And when you do a feasibility report, especially for the federal government, doing anything, you start with all and nothing, and everything in between, so that you really make sure you looked at some issues.

And so sometimes people think, Well, why did you look at that? I look at it so you can compare and say, why did you not choose something else?

What was exciting about this project is that itself our first one that we're getting into where we're looking at environmental remediation of our river systems. We have flood control, bank protection that was put out there.

And I've come in and out of practice with the county and private practice as an engineer and hydrologist, but started with the county back in '79 when we were just thinking concrete and soil cement.

Then we had the bright idea yeah to put some handrails and pretty soon we started having some

trail systems; and what I like to think is we took the washes and rivers from the alleys and made them our front door. And so they are really a benefit to our community.

Environmental restoration provides another value to what we're going to do. We've lost habitat, we want to be able to restore it. We also wanted to blend it in with the many recreational features and flood control features along the -- in this case the Rillito River from Campbell to Craycroft.

With the Corps, with their funding that we get, plus with their expertise, we're able to really look into depth into the biological habitat in ways that we couldn't do several years ago. We've looked at the cultural resources which are historical and prehistorical, are so significant along our rivers, and we've been working very closely with our -- the City and County Parks and Recreation departments, as well as the U of A Farms and a lot of the other people that have -- hold the river system, the trail systems, equestrian uses so near and dear to their hearts.

So we've had some meetings and gotten a lot of input, so we're really pleased. I do want to remind you this is a feasibility study I, the County has a number of projects out there that we're working

on at one stage or another.

This study assumes that our River Bend Park is in place, and so -- and any of the other park projects we already had planned, so this will be integrated around, understanding that both some of these parks are still in concept design as well as this being a feasibility.

But we are going to be moving forward hopefully looking at this alternative. It has a very good cost to benefit ratio, so we're hoping to get authorization from the -- from Congress to take this into design where we can more integrate the different features.

I'd now like to turn this meeting over to Ruth Villalobos; she's the Head of Planning with the U.S. Army Corps of Engineers, and she's been a key person for us to work with and someone that has really helped us develop this project.

Ruth?

MS. VILLALOBOS: Thank you. Thank you, Susan. Thank you all for joining us here tonight. I don't want to blow you out; if I'm talking too loud raise your hand in the back. But it does sound really loud up here in the front.

Thank you all for joining us tonight.

We're really excited to see this many people showing an interest in one of the projects that we have here in Pima County. As Susan said, we have a number of different projects that are in the feasibility stage, we have a few things that are under construction, and a few other ones pertaining to environmental restoration that are in the design phases that we're hoping to go to construction with in the next year or two.

Joining me here today are members of our staff at the Corps of Engineers including Mr. John Drake, the project manager for this project, and actually he's the project manager for all of our Pima County projects, so he's down here probably more than he's at his home in the Phoenix area.

Also I'd like to introduce Ms. Kathleen Bergmann who is the principal planner on this project and has been with the project from the beginning. John Moeur, the Environmental Coordinator and Biologist for the project, Joe Dixon, who's the Chief -- he's at the back by the door, he's the Chief of the Water Resources Planning Section here in Arizona for both Arizona and Nevada.

Also tonight we have Bill Miller at the back, who is just returned six weeks ago or so from Iraq doing business over there for the Corps of

Engineers, and Jeanine Divis, who's also on our planning staff.

In addition to our staff we have several consultants here; Eldon Craft, who's with David Miller Associates, and Lori Woods with Recon, Incorporated. Thanks also for being here.

Tonight we'll be presenting to you our findings of the El Rio Antiguo Rillito River Pima County, Arizona Feasibility Study and Environmental Impact Statement, and we'll present our proposed recommendation for the Ecosystem Restoration and Recreation Plan.

I'd also like to thank Pima County not only for all the arrangements here tonight but for the intense effort that they've been through with the Corps of Engineers over the past couple of years in trying to make sure that we all did a really thorough job of looking at alternatives and doing the analysis and the many different disciplines that you'll see reflected on the slides tonight.

Our main purpose tonight is to hear from you. We want to hear your ideas, your comments and your questions about what we and the County representatives have been working on here for the last couple of years.

This is on the Rillito River and some of the tributaries between Craycroft Road and Campbell Avenue. And Kathy, you're going to point out as we get into the slides some of the features on the slides. We do have other graphics that are similar to the ones that you've seen at the back of the room tonight.

Please fill out your speaker cards so that we can have those to call upon you for comments or questions and such tonight. And then also we have cards at the back of the room if you'd like to comment and mail those in to us at a later date as well.

All of the comments that we receive will have a written response to them. So please do that and either send them in today or mail them in later.

Let me describe tonight's agenda. I'll present the study findings and the details of our proposed recommended plan. This will include the study area description, a summary of our involvement in the studying of the Rillito River, the problems that we address in this particular study, this study's objectives and considerations, the alternative planning that we've done, our proposed or recommended plan, where we go from here, and most importantly, the comments from you tonight.

The study area is located on the reach of

the Rillito River from the confluence of the Tanque Verde and the Pantano Wash at Craycroft Road downstream to Campbell Avenue. The study includes the tributary confluences along this reach and the bend area.

This reach is approximately 4.8 miles long, and is protected with soil cement bank stabilization except at the tributary mouth and the area of the south bank between Columbus and Alvernon.

This bank stabilization project was done in partnership with Pima County Flood Control District and the Army Corps of Engineers, and was originally authorized by the Flood Control Act of 1938. Much of what the Corps has studied and constructed within the Gila River Watershed originally began as part of authorities granted to us by Congress in 1938.

The Rillito River Protection Project was specifically authorized by the Water Resources Development Act of 1986. House resolution 2425 in 1994 authorized the review of these previous reports for Ecosystem Restoration and Protection which has resulted in the study of the reach as presented here tonight.

I'd like to describe some of these specific procedures and findings of the study along with a description of the recommended plans that help to restore the ecosystem and improve recreation. These

are the normal steps that we follow in a typical ecosystem restoration feasibility study conducted by the Corps of Engineers.

We'll identify the base line or without-project conditions. This is the condition to which all improvements and impacts of alternatives will be compared; identify the problems and associated opportunities for this resolution, then developing an array of alternatives to solve those problems.

The alternatives must include the No Action Plan which is the condition that would exist over the next 50 years if there was no federal action.

We conduct an environmental assessment or analysis consistent with the National Environmental Policy Act, and all the other Corps of Engineers guidelines and the environmental operating principles. This is an assessment of the existing environment and the impacts related to each of the alternatives. We developed strategies for minimizing, avoiding and mitigating any of those impacts.

Then we would evaluate the alternatives; the alternatives must be complete from an engineering, economic, environmental and social standpoint, and they must be feasible from all of those perspectives.

And then finally we would select a plan

for recommendation in conjunction with the federal and state policies and regulations, Pima County's requirements and preferences, and the concerns and preferences of the local citizens.

We've gone through these steps and have potentially selected a plan on which we'd like to hear your opinion and answer any questions. To include the public in this process we held an initial public meeting on November 12, 2001, and then a series of public workshops in 2002.

Tonight's meeting continues that public involvement process by requesting your comments on the draft documents, the feasibility study and the EIS. These are available or were made available for public review on December 19th of 2003. That was the date of the notice of availability that was published in the Federal Register.

This initiated the official public comment period which lasts for 45 days and will end on February 6th of 2004. Hard copies of the document for your review are located at the Tucson Pima County libraries, and we'll have a list of those at the end. The Pima County Community College and the University of Arizona libraries also have those.

We also have a web site, a Pima County

web site which is on the board, and then we also have CDs of some -- about 30 of them which we have available tonight, and if we run out of those we have a signup sheet at the back that you can request additional copies of the CD.

And then we also have about 50 copies of the Executive Summary and of the Draft Planning Document and draft EIS. Some of those are available here tonight also if you wish to have them and don't already.

Problems studied this reach include the ecosystem degradation, recreation needs and flooding on Finger Rock Wash at the bend. The problem of ecosystem degradation in this area is not a new one. Post-European settlement impacts on the ecology of the southwestern deserts have been very severe. Few functional riparian areas remain in the low deserts.

Riparian habitat is basically that which grows in and along the river systems. It includes cottonwood willows, it includes mesquite, and it includes most of the other riverine desert shrubs that you see in most of the channel areas.

Southwestern riparian areas are fast disappearing due to this urban encroachment. In more humid climates wildlife can survive outside of the

riparian environment, in contrast riparian areas in the arid southwest support about 75 to 90% of all wildlife.

Yet riparian areas comprise only about 1% of the landscape in Arizona. 90% of this habitat type has already been lost. The Rillito River was once a lush wildlife corridor connecting the Catalinas and the Rincons to the Santa Cruz River Valley and part of the Pacific Flyway. It was a continuing flowing stream with a high water table, braided and meandering, and lined with riparian communities.

Now it's a channelized system lined with soil cement, barren, and seldom seeing flows except during floods. Population growth in the Tucson area puts pressure on the already limited local recreation resources along the Rillito River.

Improving the ecosystem will make these areas more attractive to visitors and increase recreation use of this area of the river. Flood flows in the bend area from Finger Rock Wash have and will continue to disrupt the traffic and cause damage to private property in the future. Ecosystem restoration features could decrease the future flood damages in this area.

This next slide is a pretty busy slide. I'll go through several aspects on it. In coordination

with the U.S. Fish and Wildlife Service, the Arizona Department of Game and Fish and Pima County, we found no federally listed threatened and endangered species. However, 16 critical species of interest to Pima County have potential to occur in this area.

Four Pima County protected native plants were observed and restoration efforts are expected to benefit all of these species. The assessment of riverine function is to evaluate the existing and future conditions and the changes by implementation of alternative plans, and this was done using a method which would evaluate the river's ability to function as an ecosystem.

The method was adopted or was modified for Arizona streams in cooperation with scientists in the fields of biology, botany, geomorphology, soils, hydrology, hydraulics, wildlife ecology and geology. All the ologies I guess were thrown in.

This group included those tasks with project design and management, the Corps of Engineers Engineering Research and Development Center and environmental consultants, sponsors, university professors, State game and fish officers and the U.S. Fish and Wildlife Service.

Conditions along the Rillito were

compared to other riparian areas in the region such as Tanque Verde and San Pedro River areas, and Tumacacori. Ecosystem health is extremely low, especially compared to these other streams, and will continue to decrease if nothing is done.

The planning objectives for this study were developed in partnership with Pima County and in public workshops like this one. Those included restoration of the riparian vegetative communities, increasing the acreage of the functional seasonal wetland habitat within this study area, increasing habitat diversity by providing a mix of different kinds of habitats or different vegetation types within the river corridor, including the riparian fringe and a buffer area.

It also included providing flood damage reduction through ecosystem restoration to the extent that it does not impact upon the ecosystem restoration objective. And then also increasing the recreation and environmental education opportunities within the study area.

The consideration for alternatives development were the availability of the water, cultural historical and recreational proximity, opportunities to reduce flooding and avoid increasing

flooding impacts, avoiding landfilled impacts, prevention of vector, primarily mosquito control issues, public acceptability and desires, and local planning.

Assessment of potential water sources by the Corps and Pima County study teams identified these water sources that you see on the slide. They're reclaimed water -- and you can see the acre feet per year that are mentioned up here for each of these sources. So it's reclaimed water, the Rillito River itself, its tributaries, the depth to ground water, storm drains and outflows from the study area.

The existing conditions show that there is water available for restoration if it can be harvested or acquired. Since this project is in an arid region currently experiencing drought, for planning purposes water budgets for alternatives assume that establishment and sustainability of habitat plantings would require the use of purchased water from the reclaimed system which is already available to bring water to the project area, and is uncommitted to other uses.

The reclaimed water resources are expected to grow as the population increases. There should be a cost savings of water in the wetter years,

and after the vegetation has been established.

Alternatives that we looked at varied from the No Action Alternative, as Susan had said, to the restoration of the instream river corridor to the restoration of the entire river corridor including the banks and the bend areas and mesquite bogs.

Over 20 alternatives were formulated and analyzed. We began the plan formulation by looking at a wide range of measures and then combining those measures into different alternatives to come up with 20 different ones.

Three alternatives were carried forward for further analysis as cost effective and what we call the best-buy alternatives. These alternatives are included in variations -- all included variations in terracing along the river bend area and they all included water harvesting basins with improved in-channel vegetation as shown on the maps displayed around the room here tonight.

The alternatives are shown with some of their features on this next slide. Alternative 2E restores and maintains 345 acres with two sets of terraces in the bend area and a protective buffer acreage. Alternative 2F restored and maintained 289 acres, had two sets of terracing in the bend area, but

did not include the protective buffer acreages.

Alternative 2H restored and maintained 284 acres, has one set of terraces with less cottonwood and willow community, two additional acreages -- or acres each of mesquite and riparian strand and desert wash habitat, two acres less cieniga and no protective buffer.

All three will improve the habitat in the river bottom and include water harvesting at the tributary washes. Water harvesting is also included through a ditch system on the north bank between Craycroft and Swan and the removal of Dodge Bridge and a high flow and a low flow channel on the Finger Rock Wash to reconnect the tributary, that tributary with the Rillito, and to create additional habitat.

SUSAN NEWMAN: Where does that tributary come into the river?

MS. VILLALOBOS: Can you see the graphic from where you're seated? Okay. That's the high flow coming down from the north to the south.

MS. NEWMAN: And where's is that in relation to the Dodge Bridge? So it's about at the Dodge Bridge?

MS. VILLALOBOS: It's upstream of the Dodge Bridge.

MS. SHIELDS: At the Alvernon Road alignment:

MS. NEWMAN: Thank you, sorry.

MS. VILLALOBOS: Okay. The No Action Alternative assumes that most existing riparian vegetation will disappear along this reach of the Rillito. Some riparian strand or desert wash vegetation could continue to exist, but most would be replaced by invasive species and all the cottonwood, willow and mesquite are expected to disappear.

On this slide we're showing the best-buy analysis. In the No Action Plan we showed that while existing conditions are very poor they will decrease over time even further resulting in a functional score of less than two/tenths of a unit over the whole reach.

And in this slide where you see the bottom axis is AAFCUs, that's the Average Annual Functional Capacity Units, it's basically a measure of the functions that are required to create and maintain a healthy ecosystem.

And alternative 2H, this is the least costly best-buy after the No Action Plan, producing 120 functional units, and in addition improves the ecological functions from an existing level of very poor to a level of moderate, fair, good and excellent

depending on the different functions.

The incremental cost per increased function is approximately $53,000.00 per increment. Incremental acreage or incremental average costs jump to approximately 200,000 per additional unit for alternative 2F with a minimal increase in habitat function.

There's a greater increase in cost for 2E at 345,000 per additional unit with very little increase in function of the habitat for that cost. The final alternatives all ranked high in ecosystem function, were cost effective, and ranked higher in incremental cost analysis than the other alternatives.

When compared to each other, all of them meet the study objectives, all were close in functional outputs and improved the functions over three-and-a-half times what is projected for future functioning capacity.

All had expected annual flood damage reduction benefits from restoration of about a half a million dollars. However there were trade-off analysis that compared the benefits of alternatives versus the No Action Plan using environmental quality, national ecosystem restoration, national economic development, regional economic development, and other social effects

as criteria.

This analysis showed that alternative 2H is the least costly initially, has the least annual operation and maintenance cost, and has fewer social impacts. For example there are no relocations of businesses or residences in this alternative.

The proposed recreation plan was selected after evaluation of combined measures. Alternatives varied from no action to providing all recreation measures that the public had suggested. Economic analysis was used to determine the alternatives providing the most recreation benefits for the cost.

The plan had a benefit/cost ratio of 1.46 with annual recreation benefits of $94,000.00.

The next slide shows a map of the proposed restoration and recreation plans. Oh, okay. We switched.

The recreationists will be using this area in even greater numbers once it's restored because it will become more aesthetically pleasing. Therefore it's important to develop a recreation plan that would encourage enjoyment and preserve the environmental benefits that we were striving to create.

The elements of this plan were developed in addition to what exists today as part of the

county's public involvement effort. The recreation plan includes the listed elements; to direct and control recreation out of the ecosystem restoration area, and provides trails which include decomposed granite surfaces, paralleled by paved maintenance trails, for safety along this entire reach.

There will be general recreation access to the area which is very popular for hiking, biking and equestrian use along this whole reach.

The proposed plan or tentatively selected plan is alternative 2H with recreation. This includes one set of terracing at the bend, it includes eight water harvesting basins upstream of Dodge Boulevard, at tributary mouths, and a water delivery system on the north side of the river between Swan and Craycroft.

Plant communities include 116 acres of mesquite, 99 acres of cottonwood willow, 62 acres of riparian strand or desert wash vegetation within these terraces, basins and channels, and seven acres of additional seasonal cienegas or marshes.

Finger Rock Wash includes mesquite bogs fed with low and high flow channels, ramps for safety access to the river, two pedestrian bridges, maintenance parking, public parking, comfort stations, which are rest rooms, trail linkages, recreational

trails and maintenance trails are all included.

The following slides show artist's renditions of the alternatives versus existing conditions. Water harvesting basins at tributary mouths will slow the tributary flows and allow the use of that water by the plant communities within those basins.

They will use either a pipe culvert or a weir to allow waters to return to the Rillito River. Terraces will reconfigure the banks on the inside of the bend to utilize flood flows by the plants within the terraces along the banks with riparian strands on the lowest terrace, cottonwood willow stands on the middle terrace and mesquite at the highest level.

This is a comparative view of the Rillito River looking upstream of Campbell Avenue east of Country Club Road with Christmas Wash in the front center.

A mesquite strand with a cottonwood willow strand along the stream will line Christmas Wash. Cottonwoods will grow along the south edge of the stream with riparian vegetation on the north edges of the low flow channel. This artist's rendition compares the view of Swan Road Bridge looking northeast at the north bank, where Craycroft to Swan -- where the

Craycroft to Swan foothills water harvesting area will support a mesquite bog interspersed with strands of cottonwood willow.

Cottonwood willow communities will be restored within the channel to take advantage of the contributions at this location by storm water drains.

This view contrasts current conditions with a view over the Dodge Road Bridge looking east at Swan, with a mesquite on Finger Rock's high flow channel, that's the one that comes from the north to the south; in the front left on the north bank of Alvernon -- on the north bank, and Alvernon Wash on the right or south bank.

The channels are lined with mesquite and cottonwood. The Christopher City water harvesting basin can be seen in the upper mid right. This view shows the comparison between the bend area today and the bend area terraced with riparian vegetation in the river and the lower -- and the lower terrace, cottonwood willow on the middle terrace, and mesquite on the upper terrace.

The terraces will be 450 feet wide at their widest point. The Finger Rock low flow mesquite bogs can be seen on the upper right.

This slide shows the estimated cost of

the proposed plan. The cost of construction and real estate is $48 million. Much of the real estate is already owned by Pima County, and may be used as credit toward their share or the local share of the project cost.

The total cost of the project is $36,300,000.00, with three million of that in recreation cost. Annual operation and maintenance would be approximately 390,000, with an associated water cost of 850,000 during the establishment period and dry years.

The study included consideration of opportunities to improve the environment and the impacts of the alternative plans. This analysis complied with the National Environmental Policy Act Guidelines, and the U.S. Army Corps of Engineers Environmental Operating Principles. Benefits are summarized on the slide in front of you.

Other impacts are associated with construction, and are temporary in nature. These impacts will be minimized based on working with the local interests and following local ordnances.

The estimated cost sharing for the project is shown here. The non-federal share is approximately 36% of the total project cost, with most

of the local cost creditable to already-owned Pima County properties.

This is the project's completion schedule. Once the Chief of Engineers for the Army Corps of Engineers produces a report and that report is completed, the project may be authorized by Congress in this year's Water Resources Development Act.

After final designs and plans and specifications -- which are the construction drawings -- after those are complete we will execute a legal agreement or a project cooperation agreement between Pima County and the Corps of Engineers.

Then construction may begin, and that may be as soon as the spring of 2006. Construction will require about two years to complete.

We're now ready for the comment period of tonight's session. There are a few guidelines that we'd like everybody to follow so that when you speak we can make sure that we have a complete record, especially for the court reporter; and it will also give an opportunity to everybody else who'd like to speak.

We'd like you first to identify yourself, speak clearly, state any special interest or organizations that you're representing, and that we'd

ask you to confine your comments to the subject here tonight, which is the El Rio Antigua Rillito River Feasibility Study and Environmental Impact Statement.

Please keep your statements brief and to the point, we'll try to keep comments to about a two to three-minute period, and if you have longer, more extensive comments then we would appreciate you getting those to us in writing so that we may also respond fully.

Our purpose here tonight is to really hear whatever you're saying. If there are questions for clarification that we can answer quickly we'll be happy to do that with both County and Corps folks, and then otherwise we'll take the rest of the comments and be able to respond to you over the next several weeks.

And then the last slide shows comment cards, where to send those to either Kathy Bergmann or to John Moeur; and then it also shows the areas where the document is available.

Again we do have CDs and executive summaries and some of the documents here tonight if you wish to take those.

Okay, do we have speaker cards?

MS. SHIELDS: We have a few.

MS. VILLALOBOS: I'll call these in the

order that we have them, had them turned in tonight, and then if anybody else decides that you would like to speak, that's fine.

You know, raise your hand and when you speak into the microphone, then we'll note your name and address. Jean Tucker? Yes?

MS. JEAN TUCKER: I have several questions. One, my property is directly adjacent to the Swan Wetlands Project but of course these are close and interrelated. A few questions.

Number one, will the maintenance of this affect taxes? Number two, will it be county or city that does the maintaining of it later in the years? And what was the other -- oh, and how closely are these projects meeting with each other, since those property lines of each of them are right up against each other, to facilitate it being done in a nice, you know, cohesive manner? There you go.

MS. VILLALOBOS: That was a three-part question there, that was great, thank you. Let me answer the question first about how they're interrelated.

We're assuming that the Swan Wetlands will be in place before the construction of this project begins. And so we've taken that design, we're

in the design stage right now producing the final versions of the Detailed Project Report; that's the name of the report that we produce internally for review and for the funding for that.

That project design has been incorporated into this one and so we have added some features in and around where the Swan Wetlands Project would be developed.

For the other parts of the questions on maintenance I'm going to turn to Susan, but primarily those are to be maintained by the county. That's who our cooperative agreement, legal agreement between the federal government and the non-federal sponsor will be with.

MS. TUCKER: And then the taxes?

MS. VILLALOBOS: Yes.

MS. SHIELDS: As Ruth said, most of this is on actually property that the Pima County already owns or that we will acquire. We're required to do that, and Swan Wetlands is land that we already owned. Even when we did the bank protection along that stretch we had anticipated doing these functions.

We will do the maintenance. There's a couple levels of what will be some costs for the maintenance. Swan, we do want to take advantage of

storm water harvesting; and I know all of you are shaking your heads going, it's a desert.

It is, yes, it is; but at the same time we've recently, with the Corps, did some improvements at the Ajo Detention Basin and made that a restoration project.

Yes, it's been very dry, but in it's first year the Stadium District who uses it for irrigation was able to not have to buy any reclaimed water, they did it all with storm water.

And so that's pretty heavy tense use of vegetation. What we're also -- you know for the cost, it makes sense. For the cost of -- the cost of this project in O and M's, it does look high because we had to assume that we bought all irrigation water, reclaimed water.

But as those of you who've lived here for a time, you know when he do have flows there's a purge water table. So we're really hoping to slow down the flows and get the roots established, at which time the cost would go down.

It is part of what would either be paid through Parks and Recreation under the general fund or Pima County Flood Control District. We have a flood control tax levy.

So we do look at -- when we look at the economic impacts we do also look at what it would do for costs. Now we also look like, what the costs are going to be over several years as a couple things happen.

Our costs are going to go down as plants are established; the first five years is the intensive period. Also as more people move into the community, our tax base goes up. So we're hoping that -- I won't tell you that it wouldn't affect your taxes, but I'll give you example.

The flood control tax levee actually has gone down. Historically it was 75 cents per hundred dollars of assessed valuation, real property. You know we're at 35 cents, so historically we've been able to keep it down, and it's something that we're going to have to look at.

It will be one of the critical design features as we get into is where the water is, and how can we make this as low maintenance as possible. For a couple reasons. We want it to be natural, so you don't want to have sprinklers popping up, we want to keep it more the recreation features will be to keep people away from some of the areas that we want to go native.

There are areas where it's going to get

overgrown. We hope it does because that's habitat. So we're hoping that it will not increase your taxes.

But we will -- that's something during the design, they come up with a very detailed plan and we'll know for sure, we'll be doing a little bit more -- part of the design phase is even doing some more geological drillings to figure out, you know, what -- and modeling; if we stop the storm water, how much we can keep in the root zone.

And so I think that will be the kind of thing that we'll be looking at to reduce costs. Because we do want to keep down our maintenance costs.

MS. TUCKER: In that study they are putting a sense of time, I'm sure, into the mesquite issue, are they focusing on the natural way to deal with that so we don't have a problem living with spray, and dealing with chemicals?

MS. SHIELDS: Yes, even Swan Wetlands; and we'd like to now call it something else; the Swan Greenlands.

MS. TUCKER: Thank you.

MS. SHIELDS: We're not talking about ponded water, and it was actually an issue again at the Ajo Detention Basin and for the first summer in years and years and years we did have a mosquito problem in

part. Even though you had ponding there was some circulation of the water, and there's a lot of benefits even with the storm water harvesting in bringing into the plants, it's the best way to deal with water quality.

So that is first on our mind about mosquitoes as well as other things that might be attracted to the water, plus just safety.

But yes, we'll call it the Swan Greenlands.

MS. TUCKER: Thank you very much.

MS. VILLALOBOS: Also on the vector controller mosquito problems we've used a lot of the U of A brain power to help us look how to resolve some of those issues, because it is and will always continue to be an issue if we can't figure out how to get that water in and evacuate it through there, or at least circulate it to improve water quality.

So we're well aware that that is an issue and we're paying a lot of attention to it so -- we'll have to, some of that is adaptive management, you see how well the best brain power in the area can come up with plans and how well it actually functions in an ecosystem. And then you make adjustments as you go along.

The first five years of the maintenance period the Corps also participates in those costs, so it's a reduced cost to the county, it's not just totally borne by the county. So that should help in the short term at least.

Okay. Next speaker, and I know I'm going to slaughter your last name; Carl Eynatian.

CARL EYNATIAN: Eynatian.

MS. VILLALOBOS: Eynatian? Okay.

MR. EYNATIAN: I am own the property that borders on the existing rock way on the north side of the river, just west of the Country Club Bridge, the pedestrian bridge that goes across from the north to the south, and this high brush over there.

And I'm concerned when you do the terracing you're going to cut off my access to the recreation area. When you do that am I going to have to walk two or three miles to get to the access that I currently have right below my property?

What are you going to do about keeping dogs off my property? I get dogs that run around my property from people that are using the existing recreation area.

What is your timetable for taking of more of my land to build what you want to build?

Do you want me to go on? I have two more? Do you want -- I have one.

MS. SHIELDS: I'll try to address each one, but you go ahead and --

MR. EYNATIAN: Okay. The sewer line to that north side integrated quite a bit. When we granted the easement to put in the sewer line back in the '60s we were told the maintenance was going to be going on on a regular basis.

There's never been any maintenance and that sewer line is about to fall apart. What makes us think that we're going to have -- with this new project that the maintenance schedule is going to be any better than what they promised us in the past?

And I guess that's it?

MS. SHIELDS: Okay. Well the one I'm going to side step will be the sewer maintenance because I really can't address that, it's not in my department.

MR. EYNATIAN: It's a flood control easement.

MS. SHIELDS: It is a flood control easement. And we are right now; for those of you, there's many projects going on in this area. Right now the Parks and Recreation Department is doing the design

for Campbell to the Alvernon alignment trail system through there. And if I -- I understand we're saying Country Club.

You're around that outside bend and it is -- there's a lot of steep erosion along there. We've been looking at some alternatives that wouldn't occur with what the Corps is talking about, but really even just for these recreational features where we might use some retaining walls and then step back with some vegetation, because the erosion is very serious in that area. And we've been looking at that.

We don't want to take any more property in that area, and we do want to be able to at least screen you, and that's the tough part. Screen you so people don't get on your property and yet at the same time allow you still to have access to come in there.

So there are a couple axis points. Raphael, I don't -- I don't know if you have any staff here that's been working specifically on that design along Craycroft? I mean, excuse me, the bend at Country Club where you're under design right now?

MR. EYNATIAN: Just east of Hacienda del Sol Road.

RAPHAEL: We don't have anybody here this evening to represent that, but we can get you some

information.

MS. SHIELDS: We are aware of the erosion; we're looking at that.

MR. EYNATIAN: Okay, thanks.

MS. VILLALOBOS: Okay. Spencer Davis? Yes?

SPENCER DAVIS: I utilize the trail system, recreation trails to come of the development of this project. Are they going to continue to pave and maintain if we use the trail?

Because right now it ends, the pavement ends at Alvernon and doesn't pick up until Campbell. Is it going to be continued and then developed over along the whole way?

MS. SHIELDS: I'll pick that up again. The Parks and Recreation Department, and this was part, as Raphael said, it's 60% complete, is designed for the linear park including the trails from the Alvernon alignment to Campbell.

And there's a lot of different features there. There's -- where the old Circle K was at Campbell and the river there's going to be a -- you know -- a parking lot for access there; there will be some additional improvement to the pathways -- I realize they're unpaved at this time -- as well as some

additional vegetation and other amenities that are going in there. So that's something that even before this project, they're looking at.

Paved paths, we've met on our different workshop meetings with people interested both in the natural trails, the equestrian uses as well as bike trails; or for those people just even for walking, they prefer paved.

So over all the county has a plan which we've shared with the Corps in working out which side is paved and which side is more natural for equestrian; where there would be access points. So we are going to be making sure that we do keep a high level of improvements out there as far as paved paths.

MS. VILLALOBOS: And in some of the areas where we have the terraces we're basically laying the river banks back and have a set of stairstep terraces for vegetative plantings, and some of those areas we're looking to move the trail to the outside of that area so that you would skirt -- you would be up adjacent to the riparian habitat area but not always right up against the river as it is now.

Because those banks will then be terraced back and the river will be widened essentially.

Okay. Marcus Jernigan?

MARCUS JERNIGAN: My name's Marcus Jernigan, I'm a Tucson resident just representing myself, mainly. And I'd just like to say that I'm pleased with what you've shown me of alternative 2H, and I think it looks like a great way to bring back some of the richness of vegetation that historically existed along the Rillito; and I appreciate the work that's gone into coming up with that alternative.

And I have a question about public involvement. I know this is one example, but I guess I'm thinking of the actual planting of the native vegetation and also the maintenance. Would there be a way that public groups could get involved in, you know, that might help to decrease the maintenance costs and maybe the construction costs, as well as personally involving members of the public in the ecosystem restoration efforts?

MS. SHIELDS: Pima County does; if you use a lot of our river trails, you see that we do encourage groups to, you know, to adopt them and help with the maintenance.

The other issue that we have been working with -- and you know, such as the Audibon Society has been of real help to the Flood Control District in areas, both in town where we've done some restoration,

as well as some areas that we're doing restoration completely back to native, where they may be out there looking, say in that Marana area where we have a recharge/riparian area that's been developed at the Ajo Detention Basin.

They're actually providing some docents with some signage that we're putting up for them that will explain the habitat and the birds and the different things that you're going to see.

So we quite often will look at that kind of a group. Sometimes it's the different trails people that are interested in making sure it's maintained. Like I say, it's having interested people out there, just even having an eye to let us know that something has happened in an area really helps so that we can keep things up.

So we will look at those type of things to help supplement what we're doing, get people involved in some of it. We've tried to also integrate educational elements, the recharge project that we have. We have all different signs explaining the water cycle system and things like that so that schools can go to these sites and take a walk and look at it and have some kind of an educational experience.

MS. VILLALOBOS: Marcus, I would

encourage to you give your name to Susan too so that we can call upon you. Yes, she says she'll put to you work because that's a great idea also.

Susan Newman?

MS. NEWMAN: Over here. I represent myself. I'd also represent my neighborhood which is back behind the University Farms. We're probably the last of the grandfathered neighborhoods where there's still horses in the city limits.

I'm delighted to hear what you're doing, I think it's of enormous benefit to the whole region. And I'm delighted to make contact finally with someone who perhaps might listen. Because the county doesn't want to hear about this and the city doesn't want to hear about this.

You're inviting people to ride in an area, if you get down in the river, which is still very dangerous because of the amount of cement blocks and reenforcement bars that are down in there, and every time the river flows, it surfaces in other places.

And I realize with a certain amount of thrill running up and down your spine when you're riding a horse over it that you've been riding over it for a while, because the river shifted when it's flowed.

Is there, with all this road equipment that's going to be available to taking out bridges and putting in bridges, is anything going down into the river to remove any of the hazardous stuff?

I mean you're inviting people to come to River Bend Park to ride in the river; I'm not quite sure why they would and not just go out in that one area, but if you're inviting people who don't know the river to come down into it, you're asking for someone maybe to have to come up with a shotgun and shoot a horse because of what they stepped on down in the river, and it's a hell of a liability.

MS. SHIELDS: It is very difficult, because it's a natural system, if somebody goes down there and we -- but people do like to ride in the river. We have traditionally tried to keep one side of the upper park unpaved so it's appropriate for horse riding as well.

As far as -- are you talking about debris or just wet sink spots?

MS. NEWMAN: Oh, no, you got to get down there and see it. You have bars sticking up this far up in the sand, which if you didn't know it was there, a horse could step on it and that's the end of it.

A VOICE: The stuff has washed down over

the years from the floods.

MS. NEWMAN: There's a huge amount of cement been dumped in the river.

MS. SHIELDS: Yes, historically there has been a lot of stuff come up.

MS. NEWMAN: The worst of it is between Campbell and First.

MS. SHIELDS: Okay, okay. I will have somebody look at that.

MS. NEWMAN: If you're inviting people into the area it's worth having someone come down and do a little walk through to understand what you're inviting them into. Something other than walking a dog.

MS. SHIELDS: Okay, I will have someone from our maintenance and our Flood Control look at that. It is part of our area. I do walk and drive through that area a lot, but not riding a horse or not getting down into the wash; I haven't seen anything.

I know there was a big sink hole just west of Campbell that we filled in. And hope -- and hopefully we can remove some of the material. Sometimes what's buried is huge. Because we have lost some bridges or other things in the river.

And that's not so much in the Rillito but

I know there's a couple bridges there along the Santa Cruz and we may not be able to physically remove it, but maybe we can cut off the rebar, okay? Or at least post our signs.

MS. NEWMAN: Well it's of such enormous proportions that no citizen group can get down there and do anything about it.

MS. SHIELDS: We will look at it.

MS. NEWMAN: Thank you very much.

MS. VILLALOBOS: I know you have a question or a comment, but if you wouldn't mind let me call the other two people that put in slips and then we'll get to you.

VOICE: I'd just as soon stand.

MS. VILLALOBOS: Okay. Shirley Muney:

SHIRLEY MUNEY: I live in Creekside which is north of Fort Lowell and Columbus. And I received this about two days ago, which is totally unreadable maps. And I don't think that's sufficient notice for -- you'd have twice as many people here if it had arrived a week earlier.

My question is: I just went to a meeting recently about the traffic improvements that they're planning or hope to have in the intersection of Fort Lowell and Alvernon, including moving Davidson

Elementary further back closer to the river, and extending Alvernon with a bridge across the Rillito.

And I'm wondering how all of this development is going to affect what you're planning for the river?

MS. SHIELDS: We, in doing this design with the Corps, we did assume that there would be a bridge crossing there at Alvernon, and the county and the city have been working on that for some time and we've bought a lot of the properties.

There's still a lot of drainage that comes from what's commonly known as Alvernon Wash. For someone like myself who was born here, you know, I can remember when it was flowing deep; now it's pretty much a storm drain.

But it still has some problems there so we've done some modeling looking at in both cases of what would happen there with the bridge. Most of the -- we're doing improvements on both sides and we're aware of it.

Like I said, the road improvements are a little further in design. We're getting there where we're going to be going out to construction, the -- some of the park projects are -- like I said, the one segment is 60% complete from Campbell to Alvernon.

We're looking at that along with what's going on with the road, tying it so that it can later be connected on once the bridge comes in.

Then there's other areas like River Bend Park that we're still in concept but we're assuming River Bend Park will be there in place and during design we'll take that into account.

As we get into design with the riparian we'll also know a little bit more about the exact alignment of the bridge and consider that in what we're doing.

But I mean one of the key things with the bridge is to make sure that you can get -- that the trail system and everything else is still connected. I mean right now there isn't really any connectivity right there.

MS. MUNEY: And also you're going to have a lot of traffic over that bridge because it's going to connect to River Road, and how's that going to affect the wildlife in the area in the park that you're planning?

MS. SHIELDS: Well we've taken it into account, because you also have Craycroft, you'll have Swan Road Bridge, Campbell Bridge; and yes, it does have an impact, but it would -- that's one thing we

looked at without the Corps' project. What's the impact if the bridge is there and we don't do anything.

So yes, there is an impact; but on the same point, it's still a better plan than just putting up a bridge and not looking at the habitat. A perfect system you'd have free-flowing sledges through there, you'd have lots of -- maybe at that time you'll hear birds chirping all the time.

And what we have is trying to have is pockets of that still occurring, but where you also have the traffic noises whizzing by and you've got lots of other developments in and around the area.

MS. VILLALOBOS: So what Susan is saying is that we worked on a lot of different configurations of alternatives, trying to create habitats, recognizing that we're in an urban setting. And there's still a lot of value to that, especially as more and more areas become urbanized.

This is a wonderful place to live and you have continually more and more people moving out here from some of the areas back East that are under 11 inches of snow as of today; so you know that will continue to happen.

So what we're looking to do is for short term and long term creating addition ecosystem and

additional habitats so all of that isn't lost and we can restore some of it, especially to these river systems.

They provide great opportunities and certainly not only because of the river system itself, but some of the ability to harvest some of that storm water that comes in, and use some waste water that doesn't have other committed uses at this point, and do that within areas that are currently owned -- much of them are currently owned by the County. So that's what we were striving to do.

Okay, the last speaker card that I have is for V.C. Karumanchi?

V.C. KARUMANCHI: Karumanchi.

MS. VILLALOBOS: Okay; thank you, sir.

MR. KARUMANCHI: I live at 4750 Calle Chueca. I live on Swan and River.

I live at 4750 East Calle Chueca, which is the second house from Swan. And from the map, you know, it looks like you excluded that property from acquisition. And you included my property into the acquisition.

Why is that? Why aren't you take this property? You know the citizens? You know, up close to the county? And what did you create, you know, how

are you going to compensate the people when you aren't acquiring the land?

MS. SHIELDS: Well, it maybe be a bad drawing. One thing as far as acquisition, if we own it we already have acquired it, okay?

MR. DRAKE: We said we weren't going to relocate ANY businesses or residence. So we must have a map error. GIS map maps aren't always accurate.

MS. SHIELDS: So I'll come back and look at that with you, because I know where you're talking about; I know what the area that we just purchased the home coming through there. And there's a little irregularly -- irregularity down by the river too as far as where the property boundaries are.

So we'll look at that. Our intention is not to have to relocate any business or resident. There may be some vacant land or some portions of somebody's property, but we'd want to leave everything functional.

And as with acquiring any property, we look at fair market value. When they were talking about how much of the county's cost of the project has already been provided by our right-of-way, they cost this project assuming we had to buy all that right-of-way for new, so that they can credit the

county when it goes to construction, the fact that we already purchased this.

So most of it is all entirely on land that either we own, maybe it's the City of Tucson, you know, property that's already in some kind of a public, or it's like across the U of A Farms, what we have is an easement through there, so it worked out.

But I'll come back and look at your site.

MR. KARUMANCHI: All right. It has been taxing me on that land for a lot of years. You say that you want -- that you got to get me the credit for all that.

MS. SHIELDS: Yes, you will, and you'll get full market value for it; trust me, you will.

MS. VILLALOBOS: Richard Hill?

RICHARD HILL: I live at the southeast corner of River Road and Alvernon. If you drive by it you don't think anybody lives there.

I am very curious because you say you're not going to acquire, move out any residents, I look at the -- what you presented today and I'm going to be impacted by what you call the high flow from Finger Rock Wash. Is that correct?

MS. SHIELDS: Again site-specific, I'll come back and look at you.

Right now one thing on the high flow, the alignment, Alvernon alignment approximately, especially look at what we want to is a 1993 flood where it came across there, and the water tends to break to the east at first, and then later a great deal of water comes down in that direction.

So what we're going to try to do is just -- just take it along that alignment and make sure that it's, you know, a little bit more contained that it was in 1993, but still leave it natural.

MR. HILL: Interestingly enough the Finger Rock Wash -- I've lived there since 1957 -- the Old Finger Rock Wash went through Mehl Park, didn't come through me, went through Mehl Park.

And so construction over the years has changed the flow of the water.

I have one other question, completely different. They keep speaking about reclaimed water. And all you have to do is you can pick up a journal or magazine and once a month and you will find that the prescription drugs and the medicines that are being flushed down the toilets are not being cleaned out.

The sewage treatment plant cannot handle these drugs, and there are fish problems in the Chesapeake Bay and there are problems in Switzerland

and there are problems in Germany, and how are you going to protect the wildlife from this, from the reclaimed water of the prescription drugs?

A VOICE: This is absolutely a big issue.

MS. SHIELDS: It is a big issue and I will say one thing for -- you would think you'd have less of a problem in discharging sewage, treated sewage in the effluent in the west than you would back in the Chesapeake Bay and other places.

What the EPA looks at for those types of facilities where it's wet and it's going into a river, it's going into the ocean, is they look at the mixing factor. And so they allow actually higher concentrations because by the time it gets in the water they assume it will be mixed.

We actually don't have any mixing factor. So our water has to be treated to a much higher standard. But I will tell you yes, removing things like some of the prescription drugs and those things, that has become known now as a problem. And I think it's problem that's just throughout our environment, and it's not just the effluent.

So I can't speak but I can try to find out what testing Waste Water is doing. I do know that the effluent that we get at this point from our

treatment plants, we have to take out nitrogen, we have to chlorinate it, we have to take out the chlorination.

We -- it's almost drinking water by the time it comes out of ours; but I don't want to say that we take care of some of these other drugs because that is something that's come out nationally as an issue.

And I'm sure the EPA will have new regulations for us requiring us to take those things out as well. We'll look at that. I mean even storm water has water quality issues. Even, as we saw in the fire, even natural events like the fire there were water quality issues involved.

So it's hard to say that there -- there wouldn't be, but we'll have to look at it and make sure. We're not going to have it where it's water and ponding where you have things like fish and frogs, that helps.

Those are highly impacted by it. But you know we'll try to get some of that information. It will be something that I'll see that my staff gets.

MR. HILL: It's a worldwide problem, a worldwide problem.

MS. SHIELDS: Yes, it is.

MR. HILL: It doesn't make any difference where you live in the world, it's a worldwide problem.

And one of the worst ones, you know, is birth control, birth control medicine is changing the sex life of all kinds of creatures.

MS. SHIELDS: Another comment? Yes, sir?

MR. LUEPKE: Yes. My name is John Luepke, we have 22 acres 3401 East River Road. This alternative 2F here that shows that probably about half of that area is covered with light green shading for the tributaries coming in along the side, the Finger Rock Wash drainage.

I'm just wondering, it's really difficult to assess what this is all about unless we know what that means? What that shading means? And we'd be really interested to know.

MS. VILLALOBOS: Kathy, do you want to answer what the light green shading is on that?

MS. BERGMANN: Well 2F is not the recommended alternative, but a light green shading is mesquite.

MR. DRAKE: And one of the reasons it's not the alterative we're selecting, because it does relocate -- we would be required to purchase private property or relocate residents, and so I'm --

MS. SHIELDS: Just for clarification, we're showing all of the alternatives that they looked

at here for the final one, and it was 2H is the one. You have a map of that over here.

MR. DRAKE: In the far back by the cookies.

MS. VILLALOBOS: Yes, the lady in the green? Could you state your name?

MS. COLEMAN: I'm Kristin Coleman, 3401 East River Road; we're related. Anyway the Bend Area is now a National Historic Landscape and I hope that everything that you're trying to do here or change has been, you know, run by those people, because we have to go along with whatever the historic landscape allows.

MS. SHIELDS: Yes, we understand that. *Linda Mayro from our Culture and Historic Office at the County plus --

MS. COLEMAN: You're working with her?

MS. SHIELDS: We're working with her. We're understanding that, and this is a unique area because from farm fields it's more linear, which is not always the same as riparian.

So it is a challenge, we are working with here, it's one of the things that we're -- you know, that we've reviewed in some details for the -- and we've tried to mitigate or not do any impact. And if we have to put something back, you know, put it back to

that kind of a linear feature.

We're hoping by having some of this more natural vegetation -- if you go back to the '40s there was the historic landscape but you also had a little bit more of a river there, so we're -- we are considering that.

MS. VILLALOBOS: Yes, the gentleman in the plaid shirt?

MR. BELDON: (?) Yes, my name's Beldon and I live at Town and Country School, which is southeast corner of Fort Lowell and -- Columbus and Greenlee. On these schematics I noticed that the vacant land which is on the northeast corner of Columbus and Greenlee doesn't appear to be included.

At the last meeting that I was at, where this same subject in this same place, I think about a year ago, they indicated that that was going to have vegetation planted on it, and that those washes entering the Rillito could probably have some changes made in them.

MS. SHIELDS: Sir, that's the -- also with the Corps, it's called the Swan Wetlands or Swan Greenlands, and the Corps actually is under design right now. We should, before the end of our fiscal year, sometime in April, May, actually sign an

agreement with them, and we're going to be doing design/build, so --

MR. BELDON: So that's a separate deal?

MS. SHIELDS: It's a separate deal, but it's further along. It's a more real deal at this point, okay.

MR. BELDON: But we understood that there was going to be another meeting. It's been over a year and I thought this mating was it?

MS. SHIELDS: We Are going to have some more meetings, there was -- there was a delay in getting some of the design work done, but we will be having another meeting and we'll make sure that everybody interested in it knows about it.

MR. BELDON: The main thing is the county has no plan to sell that land to a developer?

MS. SHIELDS: No, no, we do not. You know I can't tell you the number of times people call me up trying to buy different lands at different locations, thinking that one, they'll pay me what it was worth before it was bank protected.

MS. NEWMAN: No; of course, of course.

MS. SHIELDS: And that area is -- there's so little in that as you go along the river, you know, sometimes it's narrow, and it has to be because we're

trying to avoid impacts to home owners, or there's something else there.

And then what makes it work though is you come to another place and it's open because we have more land that's available. So no, we're not going to sell or develop that area, it will be part of our River Park System.

MS. VILLALOBOS: Yes, the gentleman in the blue?

MR. JOHN SCHROEDER: My name's John Schroeder, I've lived for 40 years next to the county on River and Craycroft on the north bank of the Rillito there. I see a big yellow line and it looks like it goes all around my property, and I just want to talk to somebody to see if you're trying to get my property.

Is the design far enough along or did you just arbitrarily draw a big double line?

MS. VILLALOBOS: I'm sure Susan would love to have your property, but that is not the intent of this project.

MR. SCHROEDER: Again where the exact boundaries are that you're going to try to rejuvenate here?

MS. SHIELDS: Right; now keep in mind with the feasibility and also the level of these

drawings, it's more illustrative of what we want to do. The intent would be not to be taking any properties. You know, I believe -- so you're --

MR. SCHROEDER: We adjoin the county properties, that's old houses. You won't encroach on my property?

MS. SHIELDS: And this is A feasibility concept. There are some lines -- just clarification -- there's some lines that identify the area of study, you know, and that will be a bigger area. What he was referring to, some of the yellow bubbles where that was more for illustrative areas where you'd have access, trails or those type of things. And so again it's more illustrative.

Once you get into design is when you look at real live property boundaries. This is a huge reach of the river and so it's hard to jam all that in a map where you can both read it, so sometimes our lines get huge too.

Because if you made it real size, if you tried to draw on a map like that, an eight foot path or 12 foot path you couldn't see it; so just a reminder.

MS. VILLALOBOS: The lady over here?

BARBARA CAIN: Yes, Barbara Cain and I live at Hacienda Del Rio which is right at Swan and the

bridge there. I guess you'd say we're adjacent to Basha's. We use the River Walk Park a lot, and in the three and a half years I've been walking there, I've seen one park ranger.

So my question is: If we're adding extra parking lots and more access, and we're bringing more people in here, is there also a plan to increase the budget for park rangers, so that once in a blue moon somebody walking up and down there to keep some of the criminal elements and people towing the line, so to speak?

Because I do see people trespassing on private property and things like that as we're going along. And I wonder why -- I know we don't have the funds right now, I called one time and it was like six rangers for the county or something like that but will there be funding for someone to?

MS. SHIELDS: Yes, we're hoping for -- something Raphael and I are trying to work on it so that we add some park rangers. And we also work with the city police as well as the sheriff's department, and right now we have a task force to try to look at some of the problems and better controls along the river, both to keep ATVs from getting down into the rivers where they're not supposed to, you know.

Hew do you do that and make sure people can still get in with the things that they need? We have to post signs. You need to stop them, but not in a way that they can harm themselves. So we've been having some meetings with all of the law enforcement.

Because our rivers are throughout, not just in Pima County but the city, Marana, talking with some, I've been talking with Pima trails people, identifying some places. Hopefully we will have some more park rangers.

One thing that does help when we call these maintenance trails to do maintenance, actually just getting in there and getting a proper trail system allows us to get better access ourselves to get in to watch it.

It's another reason why, too, we like to work with other groups that are interested, so that they -- so we have eyes and ears out there. Because there are problems.

MS. CAIN: The homeless people cutting through our development to access the Basha's dumpster. So we're -- it is a concern.

MS. VILLALOBOS: Yes, the gentleman here? I'd like to ask the folks at the back of the room, Carla, some of the folks back there, if you could

either keep your voices down or move over to the side a little bit I think that would help the rest of the group to hear. Yes, sir?

RICHARD SHAPIRO: My name is Richard Shapiro and my address is 5211 East Camino Francisco, so I'm up towards Craycroft and Sunrise. And my concern is with the northeast-most reach of this project, where the Craycroft wash comes in.

There's an equestrian facility in the Craycroft Wash. The Craycroft Wash is a designated trail, and I know there's going to be a widening of Craycroft, a realignment of River Road, and how is this all being addressed to get equestrian traffic safely from the Craycroft Wash through all of that traffic and into the Rillito?

MS. SHIELDS: It will be something that we look with in their design. It will also though with any road improvements, it is something that we have to look at too. We want to preserve the equestrian access down into the washes, whether that is by creating larger culverts so you can get in and out.

We are aware that that's a major equestrian trail and something that we're considering, both in the design of this as I'm sure they're doing that with the roadway.

MS. VILLALOBOS: Yes?

A VOICE: One of the things I might add to the lady's issue about, because I live right near where you do from behind Basha's, but I live over in Creekside Development bordering the Swan Greenlands project; and one of the things about transients, I've lived in there since about '85, '86ack and take care of you.

You are your best police force, and the neighborhood that is active, that calls any time somebody that is a trespasser if there's -- there's transients living under the bridges down there starting fires to keep warm; I'll try to give them a blanket but I don't want them to start a fire down there by my house.

But my best thing is to call and report it and talk about it. I agree with her that in walking along that area from Swan towards Alvernon, one of the problems I look at is maintenance long term too, because there is a lot of litter, a lot of garbage.

Look at the movie theaters, it's no different anywhere else you go, people throw it on the ground.

So you know, if I walk the trail, you know it's probably all of our responsibility every once

in a while to pick up a few pieces, throw it in a bag, take it home with you; but somebody should be doing that maintenance.

But so far as the criminal element I think we all have to get pro-active about calling and knowing where to call and how to do that. You know we used to have parties and big bonfires and ATVs; it was a big issue back then.

MS. SHIELDS: And we do try enforcement. Most of that land, like I said, we're the property owner and so we have to post, and we'll post for a while and then we send in the sheriffs or the city police, depending on where we're at.

And so our general phone number, I think that's on the handouts in back for the Flood Control District, you call us. We do take care of that because we are concerned about it. And if there are people living in our washes, yes, we have to come through and do -- we tell them where some of the community services are.

We don't just kick them out, we have to post so that they know legally they're not allowed to be there. And yeah, sometimes we have to do this time and time again, but it is something that we do.

MS. VILLALOBOS: Yes, the lady in the

back?

MARIANNE McNANCE: I haven't been at any other meetings. My name is Marianne McNance,, and I live right near where the new River Bend Park may be. I'm in that historical area.

And you're talking about diverting all this natural runoff and flood water to harvesting basins, and controlling the natural flow and the tributaries to affect the flooding.

But all of us along that River Road have private wells, and we get a lot of our water from the natural flooding. What's going to happen to that water, is that going to be taken into consideration in this water harvesting?

MS. SHIELDS: In terms of the water quality in your wells or just --

MS. McNANCE: I mean if you're diverting the water to all of this new riparian habitat? What's going to happen to the water that we -- we harvest our wells?

MS. SHIELDS: Actually it should help in that it slows it down; and like on Finger Rock, the thing to do, because the sediments it's a problem on the low flow. Is just to create depressions, that kind of slows down the water as it goes through so it

infiltrates.

Some of the diversion that we're talking about is areas where you get lower flows in the Rillito, is to have some pipes or something that fades the water back into the terrace where the vegetation is, so instead of the water only being able to recharge in the small area, the narrow river, it's now got a broader area and actually should help.

MS. McNANCE: Thank you.

MS. VILLALOBOS: Many of the areas on the outside of the banks are actually at a lower elevation than the banks are. So that's what we're talking going upstream and putting a few pipes there so gravity flow will allow that water to then irrigate your plants essentially.

Yes?

VOICE: You referred me to the 2F alternative, that's the --

MS. VILLALOBOS: 2H.

VOICE: Yes. Anyway it's still shaded in all green over half of our property and I was just wondering you know, if you've -- if you have made these cost projections already? I mean there must be some idea of what -- you know, what is going to be done on these particular areas of interest?

And so I would like to be able to know what the idea Is, and I would also like to know what the possibility is of property owners getting with the Corps of Engineers and doing some mitigation projects as far as storm runoff goes?

You know, in lieu of putting concrete channels in down through the property?

MS. SHIELDS: We don't want concrete channels. What I might suggest is those property owners that feel like we're really close to them or are we bothering their property or something like that, we can blow up the aerial and send it to you, and also meet with you and talk to you about it.

So in the back there where Carol and Alicia are, if you make sure you have a mailing address for us, and --

WHO: No interested in growing zone?

MS. SHIELDS: At this point not any engineering drawings because we haven't gone to design. But one of the real benefits of a public meeting is to know and then get to know the contact person.

And where you're interested and concerned, because mailing addresses are sometimes different than, you know, the address that's on the ground. But we'd be happy to share with you what

information we have. Also take down information that you would like to have considered.

And then that can be done even before we get into the design; it could be, you know, part -- part of what we want. Even I as the County with the county property owners, we're going to be looking at these things and making some suggestions to the Corps. just as we go along and do our project.

So anybody who has, you know, property specific, please make sure that they have your address and that you wanted property-specific address. We'll take an area, we'll blow it up and we'll show you more realistically what we're looking at, and if we have like typical drawings of what we might put in the area; because we do have like typical cross-sections, we'll include that too.

A VOICE: It's just tough to make an intelligent comment on something you don't know.

MS. SHIELDS: Yes, we will get the information to you. And while there's like this formal comment period, we will continue to have public meetings in the Corps projects. And yes, the Corps projects -- maybe you don't hear from us for a year or something.

As we move forward in projects and we

actually get in design we typically have more meetings because there's more information to go through. Feasibility is a lot of looking at what if, and so -- but and the projects I've worked with John drake many particularly have a group set up to review -- you know, citizens' group to review what we're doing as we go along. Get input into the design.

And in many cases we have them even working through construction with us so that there's a lead input. So by getting your information we'll be sure to we contact you and keep you informed.

MS. VILLALOBOS: And in one hand you know it's difficult for you to make a decision or to make comments because we don't have real hard drawings out there that you can relate to, you know, with your properties, etcetera.

On the other hand in our minds we'd rather have your input now to know what the issues are and what areas to try to avoid before we go to that next step, which is the hard design.

So we'd like to try to work hand in hand back and forth on some of those real issues. So I think it's real important for folks to make sure that they've got that indicated on your signup sheet, maybe circle your name or put specific property owner or

something?

Yes, ma'am?

MS. CARMEN CHRISTY: I'm Carmen Christy, I live 3160 East River Road, and I know there's a plan going along the whole watershed all the way to the Rincon. From Swan on say up to Cloud Road area.

What is your plan there and how soon are you going to be implementing that, that part of the restoration?

MR. DRAKE: Currently we don't have any studies underway above Craycroft.

MS. SHIELDS: Well I'll correct you, John. There is another project which is more of a -- it's in design is the Bank Protection Project, and we're looking at buying or making sure we have preserved through conservation easements the area that's to the north side of the area.

When we hit Craycroft it begins to be a transition period for a lot of what we're doing. When you're in an urban area, it's more hands-on parks, playing, then you get trails. As we get further up in our long-term plan on like the Tanque Verde and Agua Caliente, the county also has what's known as a Flood-Prone Land Acquisition Program. We try to buy the property from willing sellers or buy conservation

easements so we can leave those upper watersheds alone.

It's very, very important. We've done studies with our own Santa Cruz or the Tanque Verde, and if those areas were to be truly channelized the downstream flooding would really increase.

So our plans are to transition those more passive equestrian uses, still heavy there, but there's been the question of, where to we put bike trails? Those type of things.

Because at that point you don't want a heavy traffic intruding into, one, a habitat area, because I know talking with the homeowners up in that area they don't want real active, you know, people through their back yards if you will, so --

A VOICE: But we get them farther south, right; farther west, is that right?

MS. SHIELDS: No. It's like I say at Craycroft we have to figure out how to transition; there's that point where we've got bank protection that exists along Sabino, from Sabino Canyon Road and in that area, and people use that area of bank protection. But I'm not sure.

A VOICE: Is this not a Corps project?

MR. DRAKE: No, usually the Corps gets involved when they've asked us to; so this reach is

from Craycroft to Campbell.

We have other projects, the study's underway throughout Pima County and Southern Arizona. But we don't have -- the Corps doesn't have a master plan. So we attack -- we address each area reach with whatever problems and opportunities we're able to understand and locals bring to us; so we don't have a master, the Corps doesn't have a master plan.

MS. SHIELDS: You're talking upstream on Tanque Verde; correct?

At Craycroft is where we see things transtioning and it's become more natural and not -- ideally, and again working with parks, both city and county, ideally what we'd really like is to be able to pull and make a connection along Pantano, and that will be difficult. But that would almost get you to circle the area.

We do realize that as you get further up it's going to be more of a green belt natural area. Does that mean that there aren't people that walk through your area to use the equestrian use? Probably not. People just use the area.

But our -- you know it's a difficult thing, one, because so much developed along Pantano, that's very narrow, and then in the upstream everybody

wants to go in the Tanque Verde where there's such bountiful vegetation.

But we are trying to preserve that, that's our long-term goal.

MS. VILLALOBOS: Are there any other comments or questions from anybody out here tonight on the El Rio Antigua project then?

(No response)

Well thank you very much.

A VOICE: What do you think your time is?

MS. VILLALOBOS: Our timing is the public comment period on the draft feasibility and EIS ends on February 6th, so we'd like to hear any comments in writing from anybody that's here or anybody else that you know that wishes to.

After that we go up to our Washington office, they have a Washington level state and agency review period, and then we get a chief OF engineer's report signed in -- let's see, we're showing IN about September of '04 for all of that back and forth comment and responses and finalizing the feasibility study and the EIS.

Hopefully then if we have -- if Congress passes a Water Resources Development Act in 2004, which is the Corps of Engineers' authorization document from

Congress to say, you can go forward with this study or with this project into a construction phase, then we start the designs.

So we would be looking to start construction by about this time two years from now. It could be a little bit sooner than that if we broke off one piece of it to start construction while we're completing design of the rest of it. But I'd say two years.

Okay, any other questions?

Thank you all for being very attentive tonight and for showing up. Have a safe trip home. Thank you.

* * * * *

STATE OF ARIZONA)
) ss
COUNTY OF PIMA)

BE IT KNOWN that I, JAMES E. BOULEY, (CCR #50003) reported the foregoing public hearing; that I was then and there a Certified Court Reporter in and for the County of Pima, State of Arizona; that the proceedings were reduced to writing under my direction; that the foregoing 73 pages contain a full, true and correct transcription of the notes of said hearing.

IN WITNESS WHEREOF I have hereunto subscribed my name and affixed my seal of office this 18th day of February, 2004.

CERTIFIED COURT REPORTER

ATTACHMENT D

Species Accounts

Attachment D
Species Accounts

Plants

Acuna cactus (*Echinomastus [=Sclerocactus] erectocentrus* var. *acunensis*). The Acuna cactus has been placed on the U.S. Fish and Wildlife Service (USFWS) federal Candidate List, is highly safeguarded by the Arizona Native Plant Law, is a U.S. Forest Service (USFS) and Bureau of Land Management (BLM) Sensitive Plant, and is a Sonoran Desert Conservation Plan (SDCP) Vulnerable Status 1 species. Historically, the species ranged from western Pima County to the Sand Tank Mountains of Maricopa County and to Pinal County near Florence, and northern Sonora, Mexico. Five populations of Acuna cactus are currently known, four of which are in the United States and one is in Sonora, Mexico. The U.S. populations include one at Organ Pipe Cactus National Monument, one on private land at Ajo, Arizona, one on BLM land northeast of Ajo, Arizona, and one near Florence (Pima County 2000b). The Acuna cactus is restricted to well-drained knolls and gravel ridges between major washes and generally occurs at elevations from 1,300 to 2,000 feet. Substrates include granite and limestone hills and flats and bright red to white andesite. Known populations are located in open exposures (Pima County 2000b).

The Acuna cactus has solitary stems that usually range from 3 to 9 inches tall and 3 to 4 inches wide and are gray-green in color. The spines are reddish to yellowish with dark tips. Flowers are variable in color, but often pink to purple. The fruits are pale green and become tan when dry. Flowering occurs from March to mid-April. This species is pollinated by at least 11 species of bees. The primary germination period occurs during the summer monsoon. Illegal collection, and decline in habitat quality due to overgrazing, land development, and mining are the causes for the decline in some populations (Pima County 2000b).

This species is generally found in upland habitat outside riparian areas. Given recurring flooding and disturbance within the Rillito floodplain and urbanization of upland areas, this species is not expected to occur in the project area. It is not known presently or historically from the area (HDMS 2001).

Duck Potato (*Sagittaria latifolia)*. Duck potato is noteworthy because of its habitat requirements and historic presence on the Rillito River. This plant is an emergent plant species that grows adjacent to lakes and perennial streams. It is commonly called Duck arrowhead because its leaf shape is similar to an arrowhead. One occurrence is recorded in the Rillito River near Old Fort Lowell in 1903 (AGFD 1992). This species would not occur today due to the lack of permanent water.

Amphibians

Lowland leopard frog (*Rana yavapaiensis*). The lowland leopard frog is designated as a USFWS Species of Concern, an AGFD Wildlife of Special Concern, a USFS Region 3 Forester Priority Sensitive Species, and a SDCP Priority Vulnerable Status 2 Species. The historic range of the lowland leopard frog includes lower elevations of the Colorado River and its tributaries in Nevada, California, Arizona, New Mexico, northern Sonora, and extreme northeast Baja California, Mexico. The species currently occurs in south-central, central, west-central, and extreme northwestern Arizona (Pima County 2000b). The lowland leopard frog currently occurs at 10 to 20 sites primarily in eastern Pima County, but the present range has been severely reduced. Populations of this species typically occur in aquatic systems (prefers small to medium streams over ponds and other aquatic habitats) with surrounding Sonoran Desert Scrub, Semidesert Grassland, or Medrean Evergreen Woodland upland vegetation communities (Pima County 2000b).

The lowland leopard frog is a medium-sized frog with a dorsal field color of light gray-green, green, tan, or brown, with dark brown spots and no halos. Adults primarily eat small invertebrates and rarely, small vertebrates. The species breeds February through April, and occasionally into autumn. The population trend for the lowland leopard frog is declining, probably due to predation and competition from non-native fish and amphibians and from stream alteration and flow diversion. The species is questionably stable in central Arizona, declining in southeastern Arizona, and extirpated from southwestern Arizona (Pima County 2000b).

The lowland leopard frog has not been documented to occur nor is expected to occur in the vicinity of the study area due to a lack of perennial water (HDMS 2001). SDCP habitat modeling identified the area east of Craycroft Road to be high potential habitat for this species (Pima County 2002). The El Rio Antiguo study area is within an area identified by the SDCP as a critical landscape linkage. Habitat enhancement efforts within the El Rio Antiguo study area may expand the suitable habitat and create an important corridor for the lowland leopard frog.

Reptiles

Mexican garter snake (*Thamnophis eques megalops*). The Mexican garter snake is designated as a USFWS Species of Concern, an AGFD Wildlife of Special Concern, a USFS Region 3 Forester Priority Sensitive Species, and a SDCP Priority Vulnerable Category 2 Species. Historically, this species is found in Arizona, New Mexico, and Mexico, but has been extirpated from the Colorado River near Yuma, the apparent western limit of this snake's historic range. In Pima County, this species had been found at Cienega Creek, Sabino Canyon, Arivaca Creek, Empire Mountains, Empire Gulch, and Fort Lowell. Habitat for the Mexican garter snake includes permanent marshes, ponds, cienegas, and Sonoran riparian forests and woodlands. In general, this species requires

intact riparian vegetation communities along permanent water that is free from bullfrogs (Pima County 2000b).

The Mexican garter snake has a relatively stout body with a total length of 18 to 40 inches. Individuals are brown to greenish brown with a yellow-white dorsal stripe flanked by stripes on the third and fourth scale rows in the anterior region. The species primarily eats native frogs (including leopard frogs), toads, fishes, and small mammals (Pima County 2000). The Mexican garter snake bears up to 25 live young. Males reach sexual maturity at two years of age and females at two to three years. The species is active during the warmest season and forages around vegetated watercourses that provide shelter. Populations decreased historically with several local extirpations since 1950 as habitat is modified and exotic predators are introduced.

Mexican garter snakes were last documented near the study area in 1960 (HDMS 2001). SDCP potential habitat modeling considers the entire El Rio Antiguo study area to be medium potential habitat for the Mexican garter snake. The study area is also a SDCP critical landscape linkage for this species (Pima County 2002). The present lack of perennial water in Rillito River means during much of the year the site does not provide habitat for this species. Habitat restoration within the El Rio Antiguo study area could augment high potential habitat located immediately upstream and provide an important habitat linkage to the Santa Cruz River.

Tucson shovel-nosed snake (*Chionatis occipitalis klauberi*). The Tucson shovel-nosed snake is designated as a SDCP Priority Vulnerable Status 1 Species. The historic range of the western shovel-nosed snake in Arizona includes the Sonoran and Mojave Deserts in the southwestern portion of the state, within which its distribution is limited chiefly to dunes and similar areas having fine sand without rocks (Pima County 2000b). In Pima County, it has been found in the Avra Valley and elsewhere in valley fill areas with sandy soils, although it is believed to have been eliminated from much of this area due to habitat loss from agriculture and urban development. Therefore, its current distribution in Pima County is poorly known. The species is most abundant in flat and sparsely vegetated areas with fine, wind-blown sand. Associated vegetation includes creosote, desert grasses, desert forbs, cactus, and mesquite (Pima County 2000b).

The Tucson shovel-nosed snake is one of four subspecies of the western shovel-nosed snake. The species is distinguished from the other subspecies by black or brown secondary bands between the primary bands and usually fewer than 152 ventral scales in males and fewer than 160 in females (Pima County 2000b). The species primarily eats insects (adult and larval stages), spiders, scorpions, centipedes, and buried moth pupae. The western shovel-nosed snake is oviparous and has a clutch of usually two to four eggs lain in summer. The species nests in an underground burrow, which it digs. The population trend for this species is not well known. Although it has probably been

extirpated from part of its former range, there has been relatively little new agricultural and urban development within its range in recent years.

The Tucson shovel-nosed snake is not currently or historically known to occur near the study area (HDMS 2001). According to the SDCP, this species has a moderate potential to occur within the study area based on suitable habitat (Pima County 2002). The preservation and enhancement of mesquite habitat associated with Rillito River between Craycroft and Alvernon Roads may increase habitat quality for this species.

Giant spotted whiptail (*Cnemidophorus burti stictogrammus*). The giant spotted whiptail is designated as a USFWS Species of Concern, a USFS Region 3 Forester Priority Sensitive Species, and a SDCP Priority Vulnerable Status 2 Species. The historic range of the giant spotted whiptail includes Arizona and New Mexico. Its range in Arizona extends from the Baboquivari and Pajarito Mountains on the west, to Guadalupe Canyon in extreme southwestern New Mexico. Currently in Pima County, the giant spotted whiptail has been recorded from the Santa Catalina, Santa Rita, and Baboquivari Mountains (Pima County 2000b). Giant spotted whiptails are found in lower Sonoran (chiefly riparian areas) and upper Sonoran life zones, in mountain canyons, arroyos, and mesas in arid and semi-arid regions, entering lowland desert along stream courses. The species is found in dense shrubby vegetation, often among rocks near permanent and intermittent streams, and in grassy areas within riparian habitats (Pima County 2000b).

The giant spotted whiptail is a slender, fast-moving lizard, with a 3.5- to 5.5-inch snout-vent length and with a tail generally slightly longer. The neck, legs, and feet are dark grayish to bluish with green or pale spots, the head is reddish brown to reddish orange, and the tail is brown. The giant spotted whiptail eats arthropods, primarily insects and spiders (Pima County 2000b). The species is oviparous and breeds from May through July. Clutch size ranges from three to five eggs. Populations of giant spotted whiptail seem to be stable, although the species has been extirpated from at least part of its range and has declined in other parts possibly due to uncontrolled wildfire, overgrazing of riparian vegetation, and overcollecting (Pima County 2000b).

The lack of dense shrubby vegetation within the Rillito riparian corridor precludes this species from occurring in the study area. The El Rio Antiguo study area is within a SDCP critical habitat linkage and a potential habitat restoration area for this species (Pima County 2002). Habitat restoration associated with El Rio Antiguo may provide suitable habitat for the giant spotted whiptail.

Birds

Swainson's hawk (*Buteo swainsoni*). Swainson's hawk is an Arizona species of special concern, a USFS sensitive species, and is covered by the MBTA. Generally, Swainson's hawks breed in the western U.S., northern Mexico, Canada, and Alaska. Occasionally,

they are found on the east coast, particularly Florida, during the fall. This migratory species is found in South America during the winter months. This large raptor can be identified by its underwing coloration; the leading edge of the underwing is lighter than the trailing edge (Pima County 2000b).

Swainson's hawks require large expanses of open grasslands to forage and nest. Therefore, habitat conversion and degradation of these lands is detrimental to this species. They have been observed in orchards, desert scrub, riparian scrub, and mesquite bosques (Pima County 2000b). Prey items include small mammals, insects, birds and reptiles (Pima County 2000b).

Swainson's hawks are not known to occur on the El Rio Antiguo study area (HDMS 2001). Suitable nesting habitat is not present. SDCP potential habitat modeling identifies the majority of the study area as a medium potential habitat for Swainson's hawks to occur (Pima County 2002). Habitat restoration along the Rillito may provide roosting and foraging habitat for this species.

Western yellow-billed cuckoo (*Coccyzus americanus ssp. occidentalis*). The western yellow-billed cuckoo is USFS Sensitive, an AGFD Wildlife of Special Concern, and a SDCP Priority Vulnerable species. This species was petitioned for listing as federally endangered and on July 25, 2001 USFWS published in the Federal Register that the "petitioned action is warranted but precluded by higher priority listing actions." Western yellow-billed cuckoo were then placed on the list of federal candidate species. This subspecies of the yellow-billed cuckoo is believed to have been once widespread and locally common in California and Arizona. Its present distribution in Pima County is at Cienega Creek, Arivaca Creek, San Pedro River, Tanque Verde Wash, Rincon Creek, and the Green Valley pecan orchards. The western yellow-billed cuckoo inhabits mature Sonoran riparian deciduous forest, Cottonwood-Willow series, and Sonoran riparian scrub in well-developed mesquite bosques (Corman and Magill 2000).

This subspecies is a 10- to 12-inch slender bird with grayish brown plumage. Its diet consists primarily of hairy caterpillars, bird eggs, frogs, lizards, ants, beetles, wasps, flies, berries, and fruits (Hughes 1999). The primary threat to this species is the continued loss, degradation, and fragmentation of mature cottonwood-willow riparian habitats. The western yellow-billed cuckoo arrives in May, breeds throughout June and July, and nests in willow or mesquite thickets.

SDCP potential habitat modeling for the western yellow-billed cuckoo suggests high-quality habitat is located in the riverbend area of the project (between Dodge and Country Club Roads) and in upland habitat between Alvernon and Craycroft (Pima County 2002). However, the riverbend area has been developed and no mature cottonwood riparian forests occur in the study area. Potential habitat remains east of the study area. Habitat restoration associated with the El Rio Antiguo project may benefit this species.

Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*). The cactus ferruginous pygmy-owl is federally listed as endangered, a SDCP Priority Vulnerable species, and an AGFD Proposed Wildlife of Special Concern species. The cactus ferruginous pygmy-owl is at the northern edge of its range in Arizona. The species ranges extends from Mexico, Central, and South America, along the southern Arizona river valleys, on the Gila River and possibly east to the confluence of the San Francisco and Gila Rivers. Historically, it was recorded in the Phoenix area. A locally rare permanent resident, the cactus ferruginous pygmy owl's currently known distribution in Arizona is in several areas: the northwest Tucson and southern Pinal County areas, in and just east of the Tucson Mountains, within Organ Pipe Cactus National Monument, the Tohono O'odham Nation lands, and in the Altar Valley. Cactus ferruginous pygmy-owls have been found over an unexpectedly high range of vegetation types. Historical accounts indicate that the species used riparian habitats in Arizona; however, with the degradation of those communities, the owls are presently found in Sonoran desert scrub.

The cactus ferruginous pygmy-owl is approximately 6.5 inches in length and up to 2.5 ounces in weight with a small compact head that lacks characteristic owl ear tufts. Its eyes are yellow and its plumage is gray-brown to rufous brown. Its diet consists of birds, small mammals, lizards, and insects. It typically nests in existing cavities in saguaros, although cavities in trees may also be used.

One historic occurrence is documented adjacent to the survey area in the Santa Catalina foothills (HDMS 2001). No critical habitat is designated within the survey area. This species is not expected to occur on-site due to the limited amount of saguaros and riparian trees that could potentially provide nesting sites.

Abert's towhee (*Pipilo aberti vorhiesi*). Abert's towhee is listed as a migratory bird under the Migratory Bird Treaty Act and is a Priority Vulnerable Species under the SDCP. Abert's towhee historically ranged from southern Utah, Nevada, and southeastern California to southeastern Arizona. Abert's towhee prefers riparian deciduous woodland and riparian scrubland with a dense understory of shrubs. Its range has contracted due to loss of suitable riparian habitat. It can be found in riparian woodland remnants and is known to use mixed exotic-native vegetation in Pima County. Abert's towhee has gray-brown upper parts, with little contrast between its crown and back. Its breast, flanks, and belly are pinkish brown and its head has black markings around the bill giving the appearance of a mask. Male and female plumage is identical (Finch 1994). Abert's towhee's diet consists primarily of seeds and insects, such as beetles, ant and caterpillars. Abert's towhees mate for life and nests are constructed by the female in shrubs or trees between four and seven feet high.

Rillito River was mapped as medium to high potential habitat for Abert's towhee in the SDCP habitat modeling (Pima County 2002). The limited riparian forest and mesquite bosque communities in the study area are degraded and generally have little to no

understory or ground cover species. This offers only low potential habitat for Abert's towhee. Habitat restoration in the study area may benefit this species.

Western burrowing owl (*Speotyto cunicularia hypugaea*). The western burrowing owl is a SDCP Priority Vulnerable Species. This species is primarily restricted to the western United States and Mexico and may winter as far south as Guatemala and El Salvador. In Pima County, the burrowing owl has been found in urban Tucson, at Davis-Monthan Air Force Base and along a portion of the Santa Cruz River. Burrowing owls are uncommon residents of grasslands, open areas in desert scrub, pastures, and the edges of agricultural lands.

Burrowing owls are small-sized owls that reach 7.5 to 10 inches in length. Its head is round with a distinct oval facial ruff and it lacks ear tufts. Plumage is brown interspersed with white. Females are generally darker than males. Burrowing owls are opportunistic feeders and eat anything from insects, such as scorpions and beetles, to small mammals and birds. The burrowing owl is nocturnal and perches during the day at the entrance to its burrow or on low posts. They form loose nesting colonies in burrows made by tortoises or mammals and share foraging areas.

The SDCP identifies two areas within the El Rio Antiguo study area that have a high potential for the western burrowing owl (HDMS 2001). Both areas have been developed. Soil cement stabilization and recreational activity mean most of the project provides low potential habitat for this species. Habitat creation and enhancement could increase foraging opportunities for this species.

Southwestern willow flycatcher (*Empidonax traillii extimus*). The southwestern willow flycatcher is listed as federally endangered, is an AGFD Wildlife of Special Concern, and a SDCP Priority Vulnerable Species. Southwestern willow flycatchers are migratory birds that are known from southern Nevada, southern Utah, southern California, most of Arizona and New Mexico, western Texas, and possibly southwestern Colorado. They winter in Mexico, Central America, and northern South America. This subspecies, one of four subspecies of willow flycatcher, is present in Arizona from April through August or September. The San Pedro River is the closest known breeding location in Pima County. The preferred habitat for this bird is riparian areas vegetated with willows, cottonwoods, elders, ash, and tamarisk.

The southwestern willow flycatcher is a small bird (approximately 5.75 inches long) that is brownish olive to grayish green on the upper body parts with a pale olive breast, pale yellow belly, whitish throat, and two white wing bars. This bird feeds primarily on flies and other insects. The breeding season is May through July, with the birds usually arriving on their breeding grounds in early May. Nesting willow flycatchers have been found in three main riparian vegetation types in Arizona. All nests found above 6,900 feet were in: (1) dense stands of willows while low elevation sites were characterized by

(2) mixed native/exotic associations and (3) monotypic exotic habitat dominated by dense stands of tamarisk forming a nearly close canopy (Paradzick et al. 2000).

Currently the study area does not contain sufficient riparian habitat to support the southwestern willow flycatcher. Habitat modeling during the SDCP development indicates potential habitat for southwestern willow flycatcher on the El Rio Antiguo study area (Pima County 2002). Habitat restoration on the Rillito could provide suitable habitat for this species.

Arizona bell's vireo (*Vireo bellii arizonae*). The Bell's vireo is a SDCP Priority Vulnerable Species. Bell's vireo is found in the central and southwest United States and northern Mexico. In recent decades the Bell's vireo's range expanded to include eastern Indiana and 145 miles (232 km) up the Colorado River in Grand Canyon, Arizona. The subspecies present in Pima County, Arizona Bell's vireo (*V. b. arizonae*), breeds from southern Nevada, southwest Utah, and northwest central Arizona south to southeast California and southern Sonora, Mexico (Brown 1993). Distribution of the Arizona Bell's vireo reaches almost throughout Pima County, wherever habitat conditions are appropriate during the summer. This species prefers dense, low, shrubby vegetation in mesquite riparian forests and along desert streams and washes.

The Bell's vireo is a small bird (4.5 to 5.0 inches in length), which is generally drab gray to green above and white to yellow below. Bell's vireo is almost entirely insectivorous in the breeding season, occasionally consuming small (less than 1 percent) amounts of fruit, but its primary diet during the winter is unknown (Brown 1993). Breeding begins in April and continues until July. The Bell's vireo arrives in southeastern Arizona in March and begins its winter migration in September to Central America.

This species is not known from the El Rio Antiguo study area (HDMS 2001). The patchy riparian vegetation would likely not support the Bell's vireo. The SDCP habitat modeling identifies the eastern extent of the study area as a high potential habitat within a priority conservation area (Pima County 2002). The riparian habitat in the study area has been degraded; however, quality habitat remains off-site east of Craycroft Road. Habitat restoration in the study area would increase the likelihood of vireo to occur.

Rufous-winged sparrow (*Aimophila carpalis*). The rufous-winged sparrow is a SDCP Priority Vulnerable Species and is a locally uncommon species in Pima County. This species is resident from south-central Arizona (Pinal County) south through central Sonora to central Sinaloa in Mexico. In Pima County, specific locations include Saguaro National Park and the Tucson area (TAS 1999). The rufous-winged sparrow inhabits flat or gently hilly Sonoran desert scrub and Sinaloan thorn scrub, characterized by scattered spiny trees with shrubs and grasses and small numbers occur in oak savannahs at higher elevations. Grasslands are an essential component of their natural history.

This species is a small 5.1- to 5.5-inch bird with a gray head with black moustachial stripes and a rufous crown streaked with gray. Its diet includes caterpillars, grasshoppers, and grass and weed seeds (Lowther et al. 1999). Rufous-winged sparrows form pair bonds for life and remain in their territory year round.

A pair of rufous-winged sparrows was identified approximately one mile to the north of the site in 1981 in the Santa Catalina foothills (HDMS 2001). The SDCP identifies two areas within the El Rio Antiguo study area that have a moderate potential for rufous-winged sparrow (Pima County 2002). The westernmost area located in the riverbend area located west of Dodge Road has been developed. Portions of the moderate potential habitat between Alvernon and Craycroft Roads remain intact, but are substantially reduced. Urbanization along the Rillito River likely precludes this species from occurring in the study area. If upland habitats are restored, potential habitat for this rufous-winged sparrows may increase.

Mammals

Black-tailed prairie dog (*Cynomys ludovicianus*). This species, which once was common in Arizona, is now considered extirpated from the state. Historically, the black-tailed prairie dog ranged from Canada to Mexico throughout the Great Plains states and west to southeastern Arizona. The black-tailed prairie dog is a diurnal, burrowing rodent, approximately 15 inches in length, including a two and a half-inch, black-tipped tail. Black-tailed prairie dogs are herbivores and feed on a variety of vegetation including grasses and forbs and to a lesser extent seeds and insects. In October 2000, the Arizona Game and Fish Department began exploring the possibility of reintroducing black-tailed prairie dogs to the state. One historic record indicates this species occurred in the general vicinity of the El Rio Antiguo study area prior to 1970 (HDMS 2001). The specimen was noted in the Tucson Memorial Cemetery east of Swan Road approximately one mile south of the Rillito River (AGFD 1996b). This area appears to be developed now.

Western red bat (*Lasiurus blossevillii*). The western red bat is an AGFD Wildlife Species of Special Concern, a USFS Sensitive Species and is a SDCP Priority Sensitive Species. This bat's historic range is unclear, given the previous confusion of its taxonomy. The total range of the western red bat extends from extreme southern Canada through the United States excluding the Great Plains, south to Panama and South America. It is found in Arizona from April to September. In winter, the western red bat migrates to lower latitudes. Typical habitat includes broad-leafed woodlands, usually in riparian areas from 2,400 to 7,200 feet.

Although mainly solitary, these bats occasionally forage in family groups comprised of an adult female and her offspring. This bat is known to use thick foliage of trees or shrubs for day roosts. Roost sites range in height from a few feet to more than 40 feet (AGFD 1996c). Emerging one to two hours after dark, red bats forage on moths, beetles, flying

ants, and occasionally on ground-dwelling crickets. They usually remain within 1,000 yards of their roosts (AGFD 1996c).

SDCP identifies portions of the El Rio Antiguo study area as moderate potential habitat for the western red bat (Pima County 2001). No present or historic occurrences have been recorded near the study area. There is a low potential for the western red bat to occur in the study area due to the limited availability of suitable roosting and foraging habitat in and adjacent to Rillito River. Habitat restoration and enhancement may increase foraging and roosting opportunities for this species.

Western yellow bat (*Lasiurus xanthinu*) The western yellow bat is an AGFD Wildlife Species of Special Concern and a SDCP Priority Vulnerable Species. The historic distribution of this bat is unclear; it was first recorded in 1945 in California and not known in Arizona until 1960. The western yellow bat is mainly a tropical bat species ranging from southern Arizona, California, Texas and New Mexico, to Argentina and Uruguay. There are few records of this species in the United States; however, its occurrence is increasing particularly in urban settings in association with Washington fan palms in Yuma, Phoenix, and Tucson. There is a high potential for this species to occur at higher elevations around Tucson.

The western yellow bat has an average wingspan of 13 to 14 inches and a body length of 2.5 to 3.0 inches. Its fur is yellowish allowing it to blend with dead palm fronds. Western yellow bats give birth to one to two young in June. They roost in vegetation of palm trees and riparian deciduous trees. They are insectivores and little else is known about their diet.

The SDCP modeling identifies the upland habitat of the El Rio Antiguo study area as high potential habitat and the creek itself as medium potential habitat (Pima County 2002). Due to the limited availability of cottonwood trees, Washington fan palms, or other roosting habitat there is a low potential for this species to occur on the El Rio Antiguo study area. Habitat restoration and enhancement may increase foraging and roosting opportunities for this species.

Lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*) The lesser long-nosed bat is federally listed as endangered, is an AGFD Wildlife Species of Special Concern, is USFS Sensitive, and is a SDCP Priority Vulnerable Species. The lesser long-nosed bat has been found in southern Arizona, southwestern New Mexico, and south to the drier parts of Mexico, including Baja California. It is a seasonal resident in Arizona arriving in early April and departing in mid-to-late September. There is no evidence to indicate that the range of the species has changed from its historic extent. Current Pima County locations include the Santa Catalina, Rincon, and Santa Rita Mountains, Cabeza Prieta National Wildlife Refuge, Cactus National Monument, Saguaro National Monument, and

Coronado National Forest. Lesser long-nosed bat is known from semi-desert grasslands and desert scrub at 3,000 feet to Madrean evergreen woodland at up to 5,500 feet.

The lesser long-nosed bat is a medium-sized bat. It is grayish to reddish brown with an elongated snout. This bat has a nose-leaf, no tail, and has large eyes and reduced ears compared to other bats in Arizona. This species feeds on nectar and pollen from flowers of saguaro and organ pipe cactus in early summer, possibly feeding on ripe cactus fruits near the end of the flowering season and on agave in the fall. Pregnant females gather in maternity roosts in April and May. The young are born in late May and are fledged by June. The maternity roosts are disbanded by July.

SDCP modeling identifies the study area as low to moderate potential habitat (Pima County 2002). There are saguaros available on-site for nectaring and a limited amount of foraging habitat; therefore, there is a low potential for this species to occur on-site. Enhancement of riparian vegetation in the Rillito River floodplain would not be expected to significantly improve habitat quality for this species.

California leaf-nosed bat (*Macrotus californicus*). The California leaf-nosed bat is a federal Species of Concern, a USFS Sensitive Species, an AGFD Wildlife Species of Special Concern, and a SDCP Priority Vulnerable Species. This species is known from southern California, southern Nevada, across the southwestern half of Arizona and southward to the southern tip of Baja California, northern Sinaloa, and southwestern Chihuahua, Mexico (AGFD 1997b). In Arizona, the species is known to occur in the Sonoran desert scrub from south of the Mogollon Plateau. The California leaf-nosed bat is non-migratory and active year round, requiring rocky, rugged terrain, with caves or mine shafts mostly in Sonoran desert scrub for roosting and proximity to washes for foraging.

The California leaf-nosed bat has an erect lanceolate nose-leaf and large, joined ears, 1 to 1.5 inches long. The bat has a wingspan of 13.5 inches and is brown. It forages over flats and washes within a mile of its roost, feeding on a variety of flying and flightless insects. These bats have been observed in groups of up to 500, with both sexes roosting together during the non-breeding season, and separately during spring and summer. Fertilization takes place in the fall, although development is delayed during winter. Females congregate in maternity roosts to give birth in May and June.

The SDCP identifies the eastern portion of the study area as moderate potential habitat and the majority of the site as low potential habitat (Pima County 2001). No roosting habitat is available on-site. There is a low potential for this species to forage on-site in the desert washes and streambed. Habitat restoration and enhancement could improve foraging opportunities for this species but would not be expected to improve roosting habitat.

Occult little brown bat (*Myotis lucifugus occultus*). This species is a federal species of special concern and a USFS sensitive species. This medium-sized bat is generally found near the Mogollon Rim from Alpine northwest to near Flagstaff, including Mingus Mountain, Verde Valley, Sierra Ancha Mountains, and the Pinal Mountains. It likely occurs along the lower Colorado River valley. In summer, it is usually found in ponderosa pine and oak-pine woodland near water, or in riparian forest in some desert areas. Colonies have been found in buildings and in crevices between timbers of highway bridges. It appears that the sexes roost separately in summer, and known maternity colonies occur in buildings near permanent water. Apparently, these bats have one young per year in late June. Maternity colonies in the Southwest range from about 60 to 800 females. Occult bats generally hunt low over water for flying insects, probably including mosquitoes and midges. It may also eat a great variety of other insects including moths.

One historical occurrence has been recorded near the study area (HDMS 2001). This species is not expected to occur in the study area due to limited riparian habitat.

Pale Townsend's big-eared bat (*Plecotus townsendii pallescens*). The pale Townsend's big-eared bat is a federal Species of Concern, an AGFD Wildlife of Special Concern, and SDCP Priority Vulnerable Species. This species is known from western North America and southern British Columbia south through the Pacific Northwest, west to southern California and east to the Black Hills of South Dakota, and south to southern Mexico (Hoffmeister 1986; AGFD 1998b). In Pima County, this species is frequently found, usually no more than one or a few at a time, in inactive mines and caves, and occasionally in buildings (Hoffmeister 1986; AGFD 1998b). This species is known to use caves, mines and buildings throughout a range of elevations and vegetation communities. It has been found in Sonoran desert scrub, madrean evergreen woodland and coniferous forests in Arizona. Roost proximity to abundant water sources is also an important habitat requirement.

The pale Townsend's big-eared bat is a medium-sized bat with yellow to yellowish-brown coloration. It has large hairless ears and a wingspan of up to 12.5 inches. Its diet consists of small moths and other insects. Non-migratory residents, these bats have different summer and winter roost locations. Pale Townsend's big-eared bats mate in October and birthing occurs in maternity roosts between April and July depending on location. The young begin flying by the end of July.

According to the SDCP, low to moderate potential habitat occurs in the study area (Pima County 2001). There are limited suitable roosting sites on the El Rio Antiguo site. There is a low potential for this species to forage on-site. Habitat restoration and enhancement could improve foraging opportunities for this species but would not be expected to improve roosting habitat.

Arizona shrew (*Sorex arizonae*). The Arizona shrew is designated as a USFWS Species of Concern, an AGFD Wildlife Species of Special Concern, a USFS Region 3 and 5 Forester Priority Sensitive Species, and a SDCP Priority Vulnerable Status 2 Species. All historical records of the species are from high mountain ranges in southeastern Arizona and western New Mexico. In Arizona, they have been recorded from Huachuca Santa Rita, and Chiricahua Mountains. No known populations occur in Pima County. The Arizona shrew occurs in areas with downed woody debris, generally near surface water along drainages in mountain canyons (Pima County 2000b).

The Arizona shrew is a small brownish gray mammal, with a body length of 2 to 2.25 inches, and a total length of 3.6 to 4.5 inches. Its ears and eyes are small and its tail is greater than half the body length. Individuals eat arthropods, earthworms, and slugs. Population trends are not currently known. Uncontrolled wildfire may be destroying the downed woody debris that is associated with the locations at which individuals were captured (Pima County 2000b).

The El Rio Antiguo study area supports low to high potential habitat for the Arizona shrew according to the SDCP (Pima County 2002). A lack of cover and woody debris means that there is a low potential for this species to forage and nest within the study area. Habitat creation and enhancement associated with the El Rio Antiguo project could improve foraging and nesting opportunities for this species.

Merriam's mouse (*Peromyscus merriami*). Merriam's mouse is an AGFD Wildlife of Special Concern and a SDCP Priority Vulnerable Species. Historically, this mouse was found along rivers throughout Pinal, Pima, and Santa Cruz counties in Arizona and into Sonora, Mexico. In Pima County this species had been found at Organ Pipe Cactus National Monument, Sabino Canyon, Arivaca, Baboquivari Mountains, San Xavier, and Fort Lowell (Hoffmeister 1986). Its present distribution is unknown. Within the last twenty years, only one individual has been located in Pima County, at Organ Pipe National Monument. The mouse is known to inhabit heavy, forest-like stands of mesquite bosques and thick strands of cholla, prickly pear, paloverde, and grasses (Hoffmeister 1986). This species is believed to depend heavily on the presence of riparian woodland and dense mesquite forests, and it is unlikely they can persist where these are lacking.

Merriam's mouse has a pale gray body and a cream colored underside. It can be up to 8 inches long, with a body length of 4 inches and a tail length of 4.8 inches. There is no available information on the diet of Merriam's mouse. Merriam's mouse bears live, naked young that are dependent on maternal care. Birth can occur during any month of the year, with two to four mice per litter.

The suitable habitats on-site, mesquite bosques and paloverde-cacti desert scrub, have been disturbed by urbanization and grazing. Habitat degradation likely precludes this species from inhabiting the El Rio Antiguo site. The SDCP identifies small areas of

moderate and high potential habitat for this species in the eastern portion of the project area just west of Craycroft Street, most of which has been developed or disturbed (Pima County 2002).

ATTACHMENT E

Recreation Facilities within the Pima County/ Tucson Metropolitan Area

Attachment E

Recreation Facilities within the Pima County/ Tucson Metropolitan Area

National Parks and U.S. Forests

- Coronado National Forest
  - Santa Catalina Ranger District
    - Pusch Ridge Wilderness
    - Ricon Mountain Wilderness
- Saguaro National Park
  - Rincon Mountain District
  - Tucson Mountain District

Arizona State Parks

- Catalina State Park

BLM Lands

- Empire-Cienega Conservation Area

Pima County Parks

- Augie Acuna Los Ninos Neighborhood Park
- Cienega Creek Natural Preserve
- John A Valenzuela Community Center
- Southeast Regional Park
- Coronado Middle School Park
- Emily Gray Jr. High School
- George Mehl Foothills District Park
- McDonald District Park
- Lew Sorensen Tanque Verde Center
- Kino Veterans Memorial
- Community Center and Sports Complex
- Kino Teen Center
- Old Spanish Trail Bicycle and Hiking Trail
- Thomas Jay Regional Park
- Murphey Multi-Use Field
- Rillito River Park
- Roy P. Drachman- Agua Caliente Regional Park
- Arthur Pack Regional Park
- Casas Adobes Neighborhood Park
- Catalina Neighborhood Park and Recreation Center
- Children's Memorial Neighborhood Park
- Denny Dunn Neighborhood Park
- Feliz Paseos

- Flowing Wells Jr. High School
- Linda Vista Neighborhood Park
- Meadowbrook Neighborhood Park
- Overton Arts Center
- Pegler Recreation Area
- Picture Rocks Community Center and District Park
- Richardson Neighborhood Park
- Rillito Vista
  Neighborhood Park and Recreation Center
- Sunset Point Neighborhood Park
- Ted Walker District Park
- Wildwood Neighborhood Park
- Branding Iron Neighborhood Park
- Cardinal Neighborhood Park
- Centro Del Sur Community Center
- Lawrence District Park
- Mission Ridge Neighborhood Park
- Paseo De Los Arboles Commemorative Park
- Paseo De Lupe Eckstrom
  (Tucson Diversion Channel)
- Santa Cruz River Park
- Southwest Community Center
- Three Points Veterans Memorial Neighborhood Park
- Vesey Neighborhood Park
- Winston Reynolds-Manzanita District Park
- Ajo Regional Park
- E. S. “Bud” Walker Neighborhood Park
- Gibson Neighborhood Park
- Palo Verde Neighborhood Park
- Anamax Neighborhood Park and Recreation Center
- Continental Community Center
- Kay Stupy-Sopori Neighborhood Park
- Tucson Mountain Park
- Sahuarita District Park
- Cienega Creek Natural Preserve
- Tortolita Mountain Park
- Colossal Cave Mountain Park
- Joan M. Swetland Community Center

City Parks:

- Christopher Columbus Park
- Sentinel Peak Park
- Case Park
- Fort Lowell Park

- Golf Links Sports Complex
- Greasewood Park
- Houghton Park
- Jacobs Park
- John F. Kennedy Park
- Kino& 36th St. Park
- Lakeside (Charles Ford) Park
- Lincoln Park
- Gene C. Reid Park
- Rodeo Park
- Santa Cruz River Park
- Morris K Udall Park
- Valle Allegre Park
- Freedom Park
- Himmel Park
- Juhan Park
- Mansfield Park
- McCormick Park
- Mission Manor Park
- Joaquin Murrieta Park
- North Central Park
- Jesse Owens Park
- Palo Verde Park
- Michael Perry Park
- Purple Heart Park
- Rodeo Grounds
- San Juan Park
- Santa Rita Park
- Sunnyside Park
- 20/30 Park
- Alvernon Park
- Balboa Heights Park
- Bravo Park
- Catalina Park
- Cherry Avenue Park
- Connor Park
- Country Club Annex Park
- De Anza Park
- Desert Aire Park
- Desert Shadows Park
- Eastmoor Park
- El Presidio Plaza Park
- El Pueblo Park
- Escalante Park

- Francisco E. Esquer Park
- Estevan Park
- Fiesta Park
- Stefan Gollob Park
- Groves Park
- Hoffman Park
- Don Hummel Park
- Iron Horse Park
- Jacinto Park
- Harriet Johnson Park
- La Madera Park
- La Mar Park
- Linden Park
- Menlo Park
- Mesa Village Park
- Military Plaza Park
- Miracle Mile Manor Park
- Mirasol Park
- Mitchell Park
- Oaktree Park
- Ormsby Park
- Oury Park
- Parkview Park
- Pinecrest Park
- Pueblo Gardens Park
- Rodeo Wash Park
- Rolling Hills Park
- Santa Rosa Park
- Sears Park
- Swan Park
- Swanway Park
- Tahoe Park
- Terra Del Sol Park
- James Thomas Park
- Toumey Park
- Veinte De Agosto Park
- Villa Serena Park
- Vista Del Prado Park
- Vista Del Pueblo Park
- Vista Del Rio Park
- Wilshire Heights Park
- Harold Bell Wright Park
- Amphitheater High School
- Amphitheater Middle School

- E.C. Nash Elementary School
- Flowing Wells High School
- Pima Community College
- Sunnyside High School
- Booth-Fickett Middle School
- Catalina High School
- Cholla High School
- Doolen Middle School
- Jefferson Park Elementary School
- John B. Wright Elementary School
- Magee Middle School
- Manzo Elementary School
- Palo Verde High School
- Richey Elementary School
- Rincon High School
- Rollin Gridley Middle School
- Sahuaro High School
- Santa Rita High School
- Townsend Middle School
- Tucson Magnet High School
- Utterback Middle School
- Vail Middle School
- Manuel Valenzuela Alvarez Park
- Cherokee Avenue Park
- El Tiradito Wishing Shrine
- Garden of Gethsemane
- Jardin Cesar Chavez Park
- Mariposa Park
- Riverview Park
- San Augustine Park
- Seminole Park
- Street Scene Park
- Sunset Park
- Verdugo Park