

GILA RIVER, SANTA CRUZ RIVER WATERSHED PIMA COUNTY, ARIZONA



Public Summary Report



Pima County
Arizona



U. S. Army Corps of Engineers
Los Angeles District



City of Tucson
Arizona

August 2001

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Section 1. Overview

The Santa Cruz River Watershed Study (Watershed Study) is being conducted in response to local concerns related to environmental resources, wastewater management, groundwater management, floodplain and regulatory activities, erosion control, recreation opportunities and watershed hydrology. The study is a joint effort between the US Army Corps of Engineers - Los Angeles District and local agencies including:

Pima County Department of Transportation and Flood Control District
Tucson Water Department
Pima County Wastewater Department
City of Tucson Department of Transportation

The Watershed Study presents an opportunity for local, state and federal agencies to work together in developing watershed solutions to manage resources of the Santa Cruz River environment in the greater public interest. It will ultimately result in a recommended Watershed Management Plan, including recommended actions, to address problems and opportunities along the Santa Cruz River in Pima County, Arizona. The Watershed Study aims to develop a management plan that provides a foundation for supportable, implementable projects that strike a balance between watershed concerns of environmental protection/restoration and economic development. The overall goal of the Watershed Study is to develop a comprehensive basin-wide management plan that balances floodplain issues including development, environmental restoration, groundwater recharge, effluent and reclaimed water management, water supply and use of the Central Arizona Project water, river stability, structural flood/erosion protection, non structural flood and erosion protection, and recreation.

The feasibility phase of the study was initiated in 1997. It initially focused on defining the baseline condition of the watershed and mainstem Santa Cruz River and culminated in an August 1998 report entitled “Santa Cruz River Watershed, Feasibility Phase Assessment of Without Project Conditions.” From that point, the study focused on identifying potential alternatives to meet the above-mentioned goals and objectives. A preliminary report, entitled “Santa Cruz River Watershed, Preliminary Draft Feasibility Report” was prepared by the U.S. Army Corp of Engineers – Los Angeles District in December 2000. It documented the findings of the Watershed Study through December 2000, including updates of the existing condition and description of preliminary alternatives. The preliminary draft report went through an Independent Technical Review (ITR) by both the Corps and the local sponsors. Review comments were collected and the Feasibility Report was revised accordingly. The Final Feasibility Report (August 2001), which is the subject of this document, completes the Santa Cruz River Watershed Study.

This document is the Final Public Summary Report. It provides a brief description of the larger Final Feasibility Report and includes summaries of the technical and plan formulation elements, and a description of the overall approach of the study. For convenience, it is organized according to the sections in the Final Feasibility Report. Sections 1 through 3 provide an overview of the study, describe

the study area, and summarize public involvement. Sections 4 through 9 summarize the major technical elements of the Watershed Study. Section 10 describes problems and opportunities within the watershed in general and specific terms. Section 11 discusses the tabular inventory of potential projects that can be a part of the Watershed Plan, and also presents concept level design of selected projects. Section 12 discusses the beneficial and adverse effects of the components and Section 13 gives an overview of implementation.

Section 2. Study Area Description

The study addresses watershed management opportunities along the Santa Cruz River mainstem and in major tributaries that significantly impact the mainstem. Major tributaries in the study area include the Lee Moore Wash, the West Branch Santa Cruz River, the Rillito River (and its tributaries Pantano Wash and Tanque Verde Creek), and Canada del Oro Wash. Within Pima County, the Santa Cruz River passes by the towns of Arivaca Junction, Continental, Green Valley, and Sahuarita. It continues north through the San Xavier District of the Tohono O'odham Nation, the City of Tucson, and Marana before entering Pinal County to the North. The study focuses on the 65 miles of the Santa Cruz River within Pima County. The overall reach is divided into the six reaches listed below and shown in Figure 1.

Reach 1 - Santa Cruz County Line to Continental Road

Reach 2 - Continental Road to Pima Mine Road

Reach 3 - Pima Mine Road to Los Reales Road

(Tohono O'odham Nation - San Xavier District)

Reach 4 - Los Reales Road to Sunset Road

Reach 5 - Sunset Road to Sanders Road

Reach 6 - Sanders Road to Pinal County Line

Section 3. Public Involvement & Coordination

On October 8, 1997, the U.S. Army Corps of Engineers held an Initial Public Workshop to introduce the Santa Cruz River Watershed Study. The workshop, held at the Tucson Convention Center, served to introduce the study to interested parties and to obtain public input on the scope of study activities and watershed problems and opportunities. Almost fifty interested citizens attended the workshop. Following a presentation by the Corps of Engineers on the study background and direction, workshop participants had the opportunity to make comments and ask questions regarding the Watershed Study. Comments and concerns recorded at the workshop fell into three main categories: 1) availability of information, 2) stakeholder list expansion, and 3) data collection and plan formulation.

On March 24, 1998, the City of Tucson in conjunction with the U.S. Army Corps of Engineers and Pima County held a public Technical Information Exchange Workshop at the Tucson Convention Center. The workshop was a local initiative, suggested by participants at the Initial Public Workshop as a forum for the many stakeholders in the watershed to come together under one roof, discuss their respective roles, and exchange information. The workshop included 80 attendees and uncovered a wealth of data, much of

which was previously unknown to members of the study team. The workshop served to identify the wide range of agencies and interest groups that constitute the stakeholder. The workshop also served to familiarize stakeholders with the Corps of Engineers and their watershed planning process.

The Santa Cruz River Alliance (a citizen's group) held a Santa Cruz River workshop in Tucson on March 30-31, 2001. The Corps of Engineers - Los Angeles District attended and presented some of the findings of the Watershed Study and displayed poster size graphics depicting the study reaches, existing features and proposed projects, that were prepared as part of this study. Copies of the Draft Public Summary Document were made available for interested attendees.

The Final Feasibility Report will be published as a hardcopy and on compact disc. Copies will be distributed to the local sponsors and public libraries.

Section 4. Economics

Section 4 of the Final Feasibility Report summarizes the findings from studies of economic, without-project conditions, in the Santa Cruz River Watershed. Specific topics covered included:

- A summary of flood damages from past events.
- An economic assessment of the estimated flood damages given a 100-year event.
- A summary of existing recreation resources including local parks and river trail/paths/parks, state recreation lands, and federal recreations lands.
- An analysis of recreation demand using the federal user day method.

Section 5. Hydrology and Hydraulics

One of the key outputs of the Watershed Study was a hydrologic investigation of the discharge-frequency relationships on the Santa Cruz River for the existing and future condition. The intent was to reconcile the difference in discharge-frequency relations between agencies with an interest in the Santa Cruz River. The study included development of "mixed population" discharge-frequency relations for the stream gage records at Nogales, Continental, Tucson, and Cortaro. The technical approach involved separating flood peaks that resulted from three major storm types that affect the watershed: summer thunderstorms (monsoonal), winter storms (frontal), and dissipating tropical storms (cyclonic). The results can be used as a baseline in plan formulation tasks in the study, and to consider the impact of human disturbance and natural change on the future peak runoff potential. In an effort to coordinate consensus at the local level, the technical approach to the discharge-frequency analyses was developed with review and input from a "Hydrologic Task Force" (HTF) consisting of representatives from local agencies. A separate hydrologic analysis also looked at the low flows to characterize the availability of water for riparian vegetation and proposed restoration projects.

Hydraulic analyses included development of a continuous water surface profile model (using the Corps HEC-RAS program) of the Santa Cruz River from the Santa Cruz County Line to the Pinal County Line.

The model was assembled by combining a number of previous models from flood insurance studies and flood control projects, with updates based on field reconnaissance of current river conditions.

The geomorphologic and sedimentation characteristics of the Santa Cruz River were qualitatively described, and changes in the river invert profile and cross sections were compared using historic topo mapping. Map sources ranged from USGS quad sheets (some dating back to the 1940's) to the recent digital aerial topography done by the Pima Association of Governments in 1998. Bridge scour evaluations performed by local agencies and the Arizona Department of Transportation were also summarized.

Section 6. Floodplain Characteristics

Section 6 of the Final Feasibility Report provides a summary of findings from the Watershed Study's investigations of floodplain characteristics and activities. Key points include:

- Land ownership, land use and land use policy in the watershed
- A summary of the Pima County Floodplain and Erosion Hazard Management Ordinance
- A description of the Pima County's Floodprone Land Acquisition program with a summary of land acquired to date.
- A summary of capital improvements to prevent flood damages
- Maintenance and river management practices on a reach by reach basis
- 404 Permit Issues including a discussion on streamlining the federal permitting process.

Section 7. Environmental Resources

Section 7 of the Final Feasibility Report provides a summary of findings from the Watershed Study's investigations of environmental resources in the Santa Cruz River Watershed. Specific issues addressed include environmental resource trends, biological resources (vegetation and wildlife), biological regulatory issues, climate, air quality, aesthetics, demographics, recreation and cultural resources. Representative cross-sections corresponding to each of the six subreaches were surveyed to assess the general conditions typifying each reach as well as to discern any significant environmental trends from the upper to lower reaches of the study area. In each cross-section, the width of the apparent floodplain is approximated and the surrounding landscape and vegetative characteristics are described. Adjacent land uses and key features immediately upstream and downstream of cross-sections are also discussed. These broader descriptions are followed by a synopsis of stream flow, landform, and biotic conditions.

The report includes an Environmental Appendix that is intended to be a didactic report, in the format of an Environmental Assessment (EA), to instruct and guide in the future preparation of a bona fide EA, but is itself not an environmental assessment of a proposed Federal action. Rather, it presents the elements and required content of an EA which conforms to requirements of the National Environmental Policy Act of 1969, as amended, and implemented by Army Regulation 200-2, for a hypothetical example project. The document assumes all analyses would be commensurate with Federal statutes. It demonstrates why a

proposed action may be accomplished, under certain circumstances, without the need to prepare a more extensive Environmental Impact Statement.

Section 8. Water Resources

Section 8 of the Final Feasibility Report provides a summary of findings from the Watershed Study's investigations of water resources in the Santa Cruz River Watershed. The major topics included groundwater (supply, overdraft, and response to overdraft); wastewater, effluent, and development of the reclaimed water system; the Central Arizona Project; stormwater; and surface water. In terms of water quality, Section 8 also summarizes previously published water quality information for groundwater, surface water, stormwater, and CAP Water from the U.S. Geological Survey, the Arizona Department of Water Quality, the Pima Association of Governments (PAG), Pima County Wastewater Management, and the City of Tucson Department of Transportation. The section closes with a discussion, prepared by the Tucson Water Department, on water use and water rights.

Section 9. Geological Characteristics

Section 9 of the Final Feasibility Report provides a summary of findings from the Watershed Study's investigations of geological characteristics of the Santa Cruz River Watershed. Specific items included regional geology, soil characteristics, land subsidence, earth fissures, hazardous/toxic/radioactive waste sites, and Tucson Brownfields development program.

Section 10. Watershed Problems and Opportunities

Section 10 of the Final Feasibility Report presents a discussion of problems and opportunities at the watershed level and in more specific terms for each of the six reaches. Problems and opportunities are broadly divided into four broad groups: 1) Flood Damage, 2) Environmental Resources, 3) Water Supply, and 4) Recreation.

Flood Damage

Problems: Historically, the Santa Cruz River Watershed has been subject to severe erosion and to a lesser extent, inundation damages from devastating floods, such as those occurring in 1983 and 1993. Properties along portions of the Santa Cruz River floodplain are at risk for flood damages from future storm events. Problems of lateral channel migration caused by erosion and sedimentation throughout unprotected reaches further threaten properties.

Opportunities: Pima County has initiated the Floodplain Land Acquisition Program to identify and prioritize at-risk properties for purchase and conversion to floodplain-compatible uses such as open-space and environmental restoration sites. Such uses are consistent with evolving philosophies of federal agencies like the Corps of Engineers non-structural flood control initiatives, or other mission related activities such as flood damage reduction and ecosystem restoration. Maintaining the existing connections between the channel and the floodplain in reaches of the Upper Santa Cruz River (for this

study - roughly defined as reaches 1 through 3) will help prevent future increase in flood peaks flows and their resultant flood damages downstream.

Environmental Resources

Problems: Historically, riparian vegetation was abundant along the channel of the Santa Cruz River and its tributaries. In several areas, springs and high groundwater tables caused perennial flows or created marshy areas known as cienegas. These wetter portions of the Santa Cruz River provided valuable wildlife habitat in an otherwise arid environment. Groundwater pumping since the 1940s has lowered the groundwater table in the study area to the extent that no surface flows exist except in response to large precipitation events (that may include snowmelt), and effluent discharges. As the water-driven cienega and riparian habitats were eliminated, so were the abundant wildlife communities that depended on them for survival.

Opportunities: Many opportunities exist within the study area for environmental restoration of the southwest riparian ecosystem. While it may be unrealistic to set goals of restoring groundwater levels to historic levels and reestablishing historic groundwater-dependent riparian communities, it is possible to make significant strides in the direction of ecosystem restoration. Riparian communities that will survive on surface water flows can be restored throughout the watershed with the creative use of treated wastewater effluent and Central Arizona Project water sources.

Water Supply

Problems: One of the most significant challenges facing Pima County and the Tucson metropolitan area is the development of a sustainable water supply for the future. Consequences of the study area's dependence on groundwater withdrawal for meeting water demands are well documented. Years of groundwater overdraft have resulted in a multitude of problems including land subsidence and the resulting damage to infrastructure, losses in well productivity, increased pumping costs, declines in water quality, and the depletion of surface flows that have had devastating effects on wetland and riparian communities.

Opportunities: The Safe Yield Policy of the Groundwater Management Act legislatively requires the balance of ground water inflows and out-takes by the year 2025 in response to the growing declines in the study area's water table. The goals of the Act can be addressed by two courses of action, augmenting supply and decreasing demand. Opportunities exist throughout the watershed for both. Supply augmentation opportunities include recharging the area's depleted groundwater table and increasing use of alternative sources such as treated effluent and Central Arizona Project Water. Opportunities exist for the development of multipurpose groundwater recharge/environmental restoration projects throughout the study area. Demand management opportunities include development of expanded water conservation programs and development of educational materials and incentives to help shift groundwater use to effluent and CAP water use where appropriate.

Recreation

Problems: There is a high demand for recreation opportunities throughout the Santa Cruz River Watershed. While a master plan exists for a regional Pima County River Parks System, the

completed portions form a discontinuous network of trails, bike paths, and historical and interpretive exhibits.

Opportunities: Opportunities abound in the watershed for providing new recreational components in conjunction with the potential flood damage reduction, environmental restoration, and water supply augmentation activities described in the above paragraphs. Opportunities to connect previously completed components of the regional River Park System should be explored. Opportunities exist for the development of passive recreation activities such as trail systems through or adjacent to environmental restoration areas.

Section 11. Watershed Management Plan Components

Section 11 of the Final Feasibility Report begins with a comprehensive inventory of proposed projects and programs that address the Watershed Planning Goals and Objectives listed in Section 1, which include environmental restoration, groundwater recharge, effluent and reclaimed water management, use of the Central Arizona Project water, river stability, structural flood/erosion protection, non structural flood and erosion protection, and recreation. These proposed projects are referred to as “components” of the Watershed Management Plan. An overview of the study reaches is given in Figure 2 and locations of the components are shown reach-by-reach on Figures 3-8. Some of the proposed components, such as the City of Tucson River Park Extension in Reach 4, are well advanced and are scheduled for implementation in the near future. Others, such as the City of Tucson’s Rio Nuevo Project are still being formulated. Still others, such as the Town of Sahuarita’s bank protection in Reach 2, have only been identified as potential needs in the region. The inventory also includes existing features, such as the Santa Cruz River Management Effluent Recharge Facility, that are integral to some of the proposed components and to the overall watershed plan.

The inventory identifies more than 50 individual components that can potentially be a part of the overall Watershed Management Plan. The components were evaluated for their potential to address the goals and objectives of the Watershed Study. Based on these evaluations, input from past public meetings, discussions with the local sponsors and the Corps study team, six concepts were selected for additional analysis in this study. For each of these concepts, the Final Feasibility Report describes the existing condition (for example, flooding, erosion, and loss of riparian habitat), and the expected future condition (continued flooding and erosion, continued loss of riparian habitat) if the project is not implemented. The report then discusses the features of the proposed concept and how it will address the problems and opportunities described in the Overview, Section 1. Conceptual level cost estimates were provided when sufficient cost information for the components was available.

Floodprone Land Acquisition. In Reaches 1 and 2, one of the proposed concepts is floodprone land acquisition by local agencies to limit future floodplain development (Figure 9). Potential benefits include preserving floodplain storage to mitigate downstream flood peaks, preventing the need for bank protection to protect developed areas on the river bank, providing a base for additional recreation, ecosystem restoration, and groundwater recharge projects, and providing incidental benefits such as open

space for passive recreation and wildlife. This concept shares some of the goals in the locally developed Sonoran Desert Conservation Plan.

Paseo de Las Iglesias. Paseo de Las Iglesias (“Walk of the Churches”) is a proposed project that combines ecosystem restoration with preservation of cultural resources along the Santa Cruz River between San Xavier Mission and Congress Street in downtown Tucson (Figure 10). The project is currently under consideration by the USACE- Los Angeles District, which completed a section 905b Reconnaissance Study in July 1999. It is also a component in Pima County’s Sonoran Desert Conservation Plan. Restoration components include establishment of wetland areas and periodic releases of low flows to promote cottonwood and willow growth in the main channel. Cultural components include establishment and interpretation of the San Juan Bautista de Anza National Historic Trail, re-establishment of traditional farming areas, linkages to and interpretation at existing archeological sites, and completion of riverpark facilities. San Xavier Mission is the southernmost destination in the “Walk of the Churches”. Flood and erosion control elements are also needed in connection with restoration and cultural elements.

Multiple Benefit Water Use Projects. The City of Tucson has established Multiple Benefit Water Projects to “...enhance the livability of the community in Tucson through the judicious use of limited water resources in a variety of water related projects”. Projects under this program that are currently in development include (1) the introduction of seasonal or continuous flows into the Santa Cruz River from Valencia Road to Congress Street, (2) expansion of a 50-acre park adjacent to the existing river park near Irvington Road, and (3) establishment of a “Downtown Gateway Water Feature” that includes park facilities, open water areas, and community planting areas (Figures 10-13).

Rio Nuevo. “Rio Nuevo” is a City of Tucson proposal that combines ecosystem restoration, preservation of cultural resources, and redevelopment along the Santa Cruz River near downtown Tucson. Ecosystem components include establishment of the Mission Gardens while cultural features include restoration of the historical sites known as Warner’s Mill and Convento. The combination of the Multiple Benefit Water Projects, Rio Nuevo, and Paseo de Las Iglesias will provide an integrated plan that addresses flood control, recreation, environmental restoration, and cultural restoration throughout a 7.5 mile reach in downtown Tucson.

Santa Cruz River Bank Protection Grant to Fort Lowell. Pima County has developed conceptual designs for bank protection on both banks in the 1.5-mile long section of the river between Grant Road and Fort Lowell Road (Reach 4, Figure 14). The banks are currently unprotected and are experiencing continual and severe erosion. The proposed concept will tie into existing bank protection upstream and downstream and will also include a linear park/Bike trail on the top of the bank. Benefits include reduced flood and erosion damages, and connection of recreation elements.

Tres Rios del Norte. In Reaches 4 and 5, “Tres Rio del Norte” (Figure 15) is a locally developed concept that extends along the Santa Cruz River from Sunset Road to Avra Valley Road. It involves structural and non-structural flood/erosion control, groundwater recharge, effluent management,

ecosystem restoration, and parks/trails development. The project area includes the existing Santa Cruz River Managed Effluent Recharge Facility that receives recharge credit for infiltration of effluent along the Santa Cruz River from the Roger Road Wastewater Treatment Facility to Ina Road.

Upland Recreation. The “Uplands Recreation” concept applies to all six reaches (Figures 16-21) and proposes to further develop connections between the Santa Cruz River and existing areas of dedicated open space such as the Santa Rita Experimental Range, Tucson Mountain Regional Park, Saguaro National Park, the Ironwood Forest National Monument, Tortolita Mountain Park, Catalina State Park, and Coronado National Forest. These connections would be provided by existing river parks/paths/trails, proposed river parks/paths/trails, existing trails and washes, and dedicated bike paths. It also included the potential to expand environmental restoration and groundwater recharge projects beyond the mainstem river by extending them up the tributaries.

Section 12. Watershed Management Plan and Effects

Section 12 of the Final Feasibility Report summarizes the benefits and the potential adverse impacts of components in the Watershed Management Plan in a matrix format. As previously mentioned, benefits include ecosystem restoration, groundwater recharge, effluent/reclaimed water management, water supply and better use of Central Arizona Project water, improved river stability with reduced flood and erosion damages, non-structural flood control, and an increase in open space and recreation.

Adverse impacts vary. Floodprone land acquisition will reduce the amount of land available for future growth. Plans for restoration projects will need to include provisions for vector control and may need to address maintenance to ensure that existing flood capacity is maintained. Structural bank protection will reduce habitat on the riverbanks. Increased recreation will introduce people to generally unpopulated areas of the river and may lead to vandalism at existing cultural sites.

Section 13. Watershed Management Plan Implementation

Section 13 of the Final Feasibility Report summarizes implementation of the Watershed Management Plan on a reach-by-reach basis. For each proposed component, the summary lists the lead agencies, potential cooperating agencies, institutional authorities and funding sources, cost sharing requirements for the Corps of Engineers and other participating agencies, expected phasing requirements, and environmental and regulatory requirements.

Potential participating entities include:

- Federal: U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Bureau of Land Management.
- State: Arizona Department of Water Resources, Arizona Department of Environmental Quality.
- County: Pima County Department of Transportation and Flood Control District, Pima County Department of Wastewater Management.
- Local: City of Tucson Department of Transportation, Tucson Water Department, Town of Sahuarita, Town of Marana.

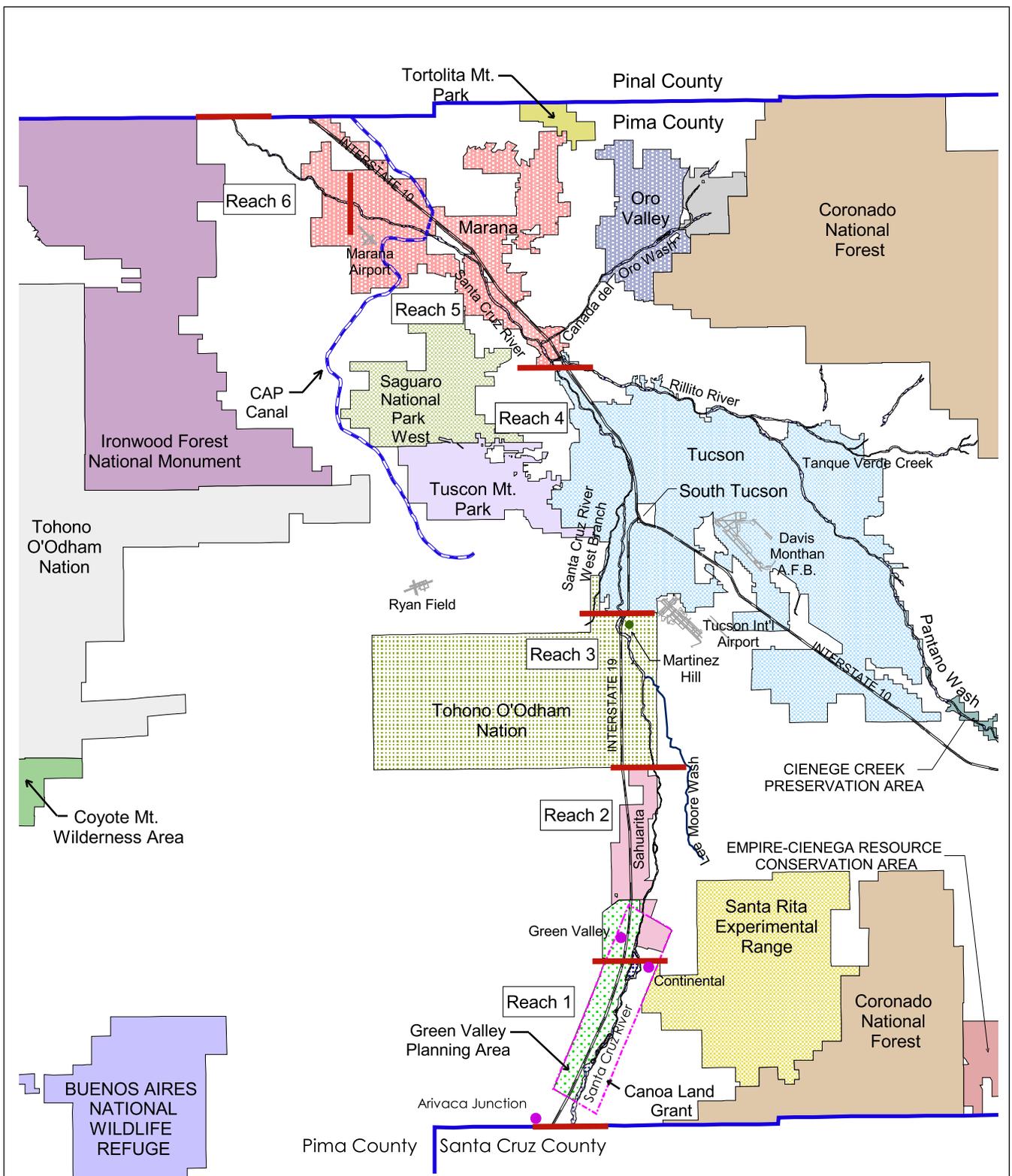
- Indian Nation: Tohono O’odham Nation - San Xavier District.

Potential federal funding sources include:

- US Army Corps of Engineers funding for structural and non-structural flood damage reduction and ecosystem restoration
- US Department of Interior, Land and Water Conservation Fund.
- US EPA State -Tribal Local Wetlands Protection Grant 104(b)(3)
- US EPA Sustainable Development Challenge Grants Program.
- US EPA Brownfields Assessment Demonstration Pilots.

Other funding sources include the Arizona Water Protection Fund, Pima County (General Obligation Bonds, Secondary Property Tax), City of Tucson, Town of Marana, Town of Sahuarita, and the San Xavier District.

FIGURES

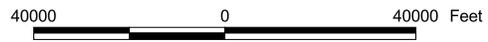


Legend:

— Reach Boundary



Scale: 1" = 40,000 ft

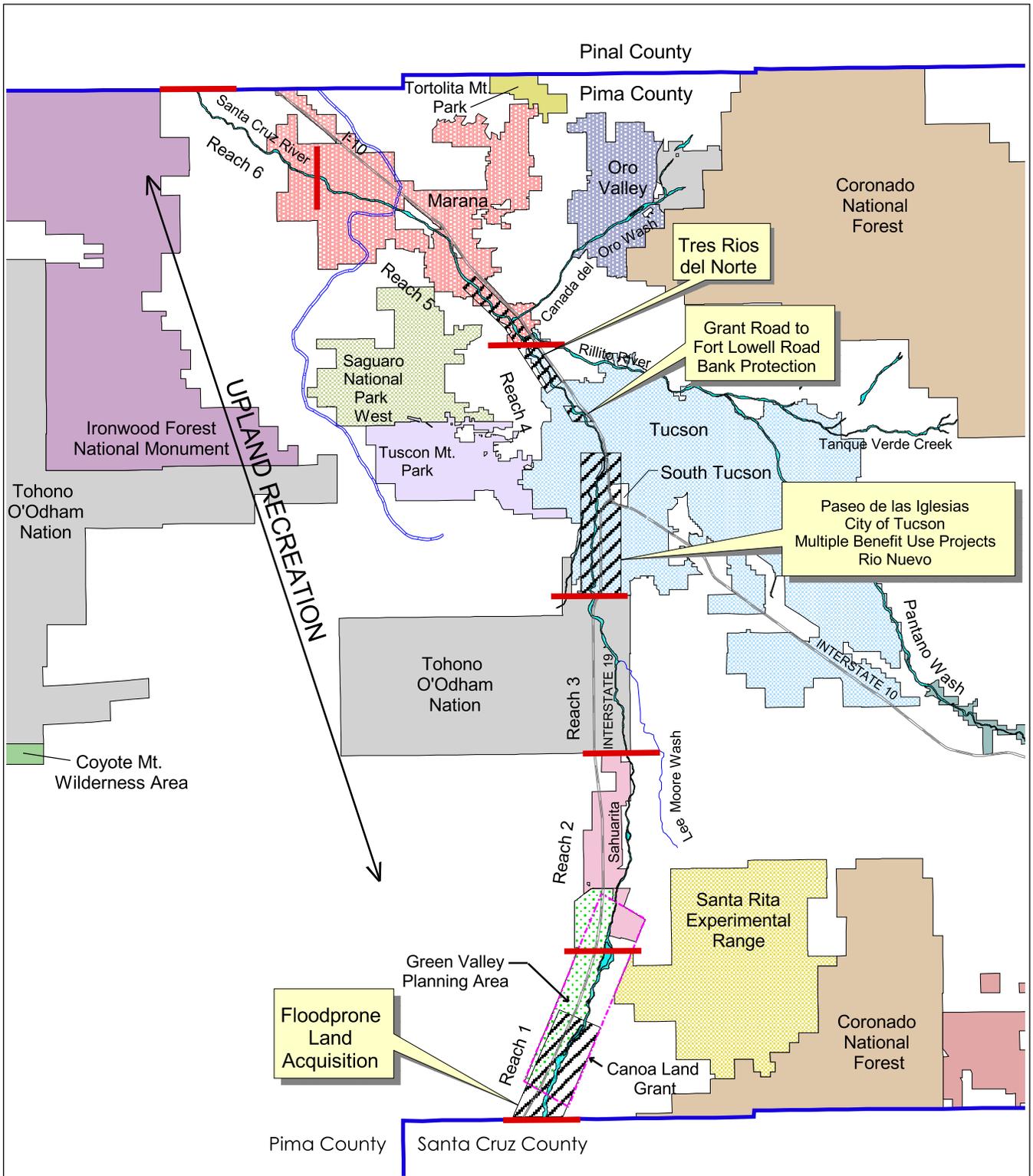


**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**

Study Reaches



Figure 1



Legend:

- Reach Boundary
- Project Concept Area



Scale: 1" = 40,000'

20000 0 20000 40000 Feet



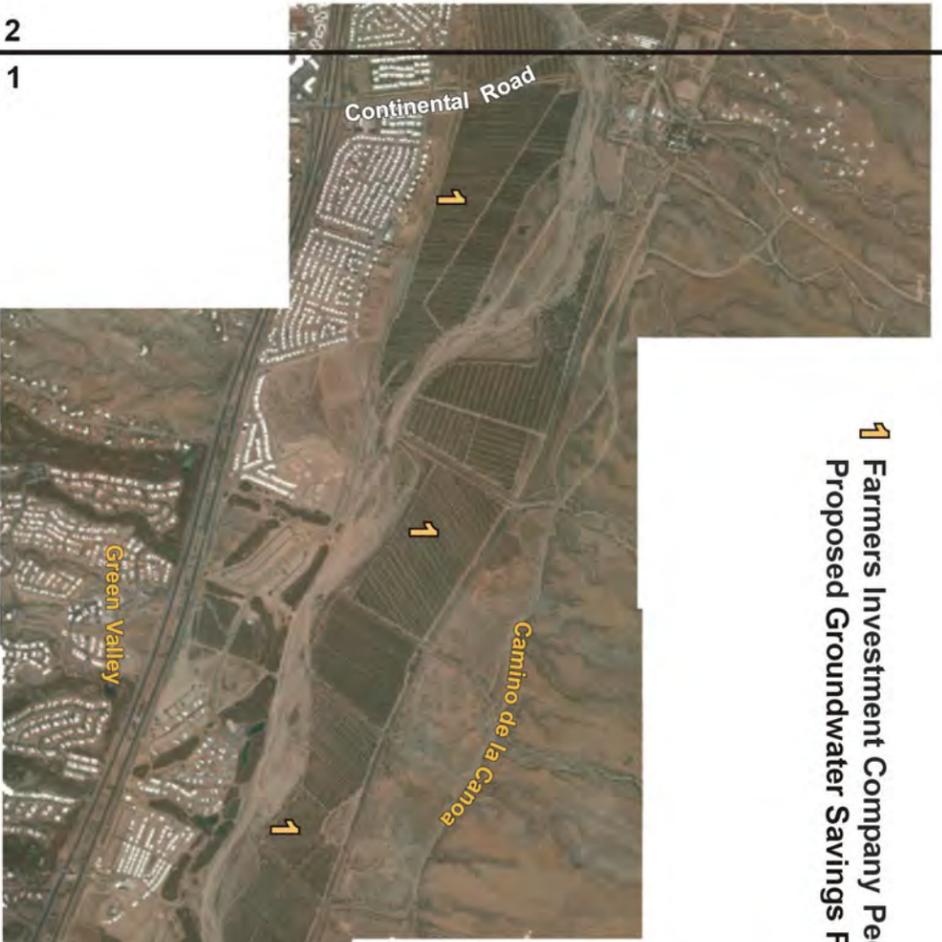
Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study

Potential Project Concepts



Figure 2

1 Farmers Investment Company Pecan Groves and Proposed Groundwater Savings Facility

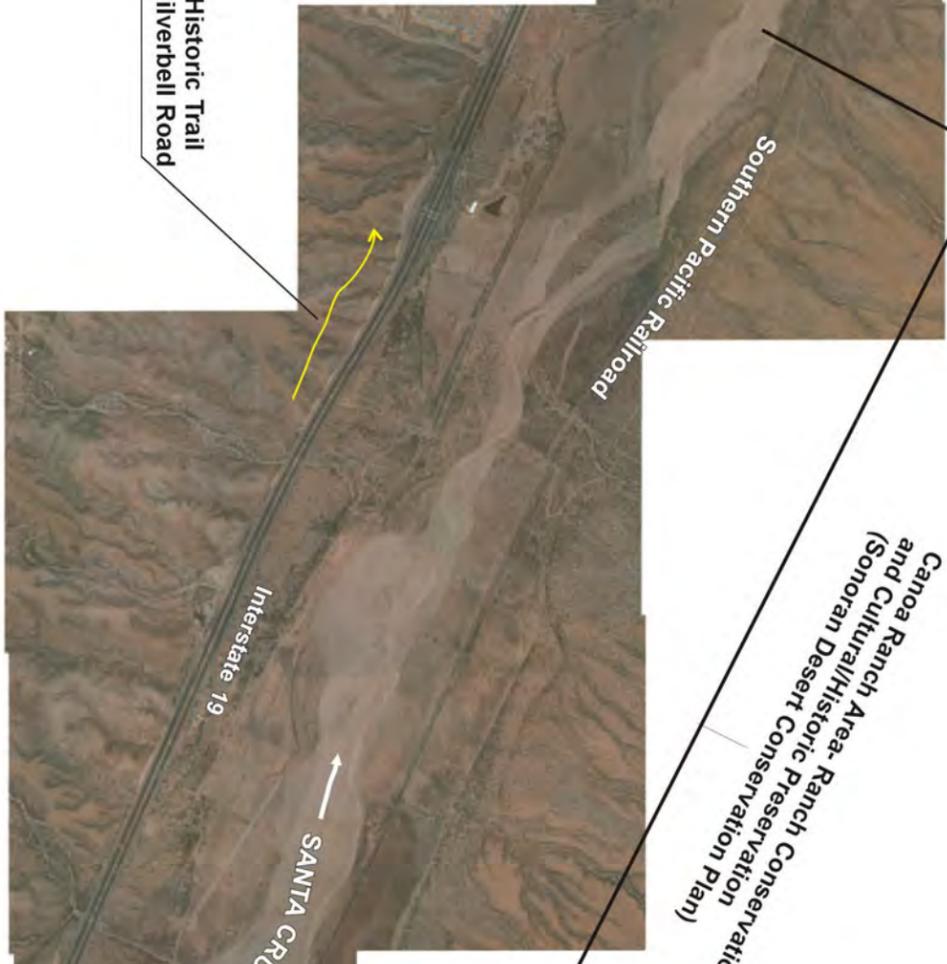


1-Mile
SCALE

REACH 1
Existing Features & Proposed Projects

SANTA CRUZ RIVER
Watershed Management Study
Pima County, Arizona

REACH 2
REACH 1



Juan Bautista de Anza National Historic Trail between Santa Cruz River and Silverbell Road

Canoa Ranch Area- Ranch Conservation and Cultural/Historic Preservation (Sonoran Desert Conservation Plan)

Amado Ranch Area-Potential for Ranch Conservation and Cultural/Historic Preservation (Sonoran Desert Conservation Plan)

Arivaca Wastewater Treatment Facility (to be closed)



Pima County
Santa Cruz County

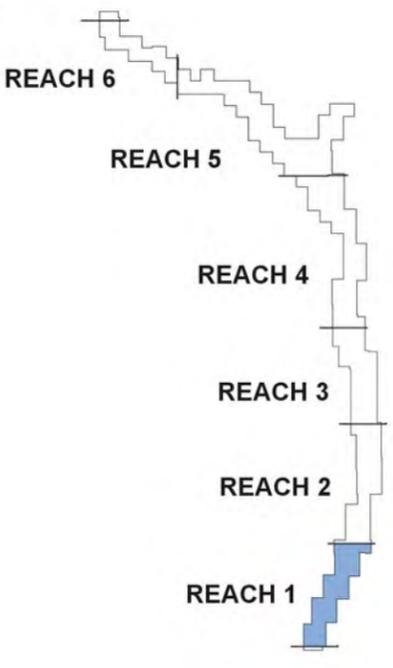
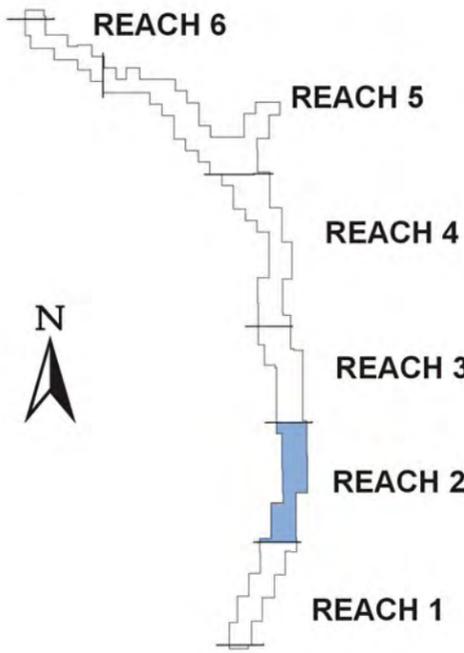
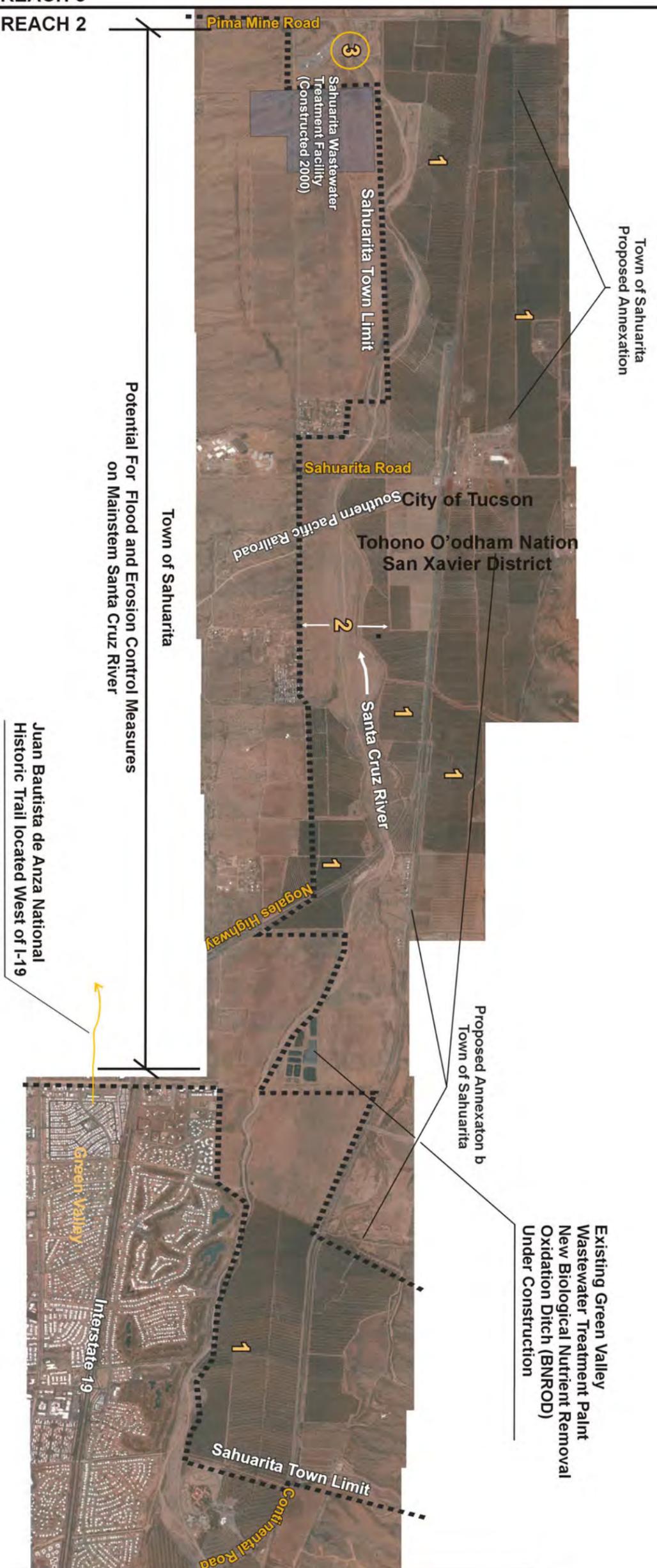


FIGURE 3

REACH 3
REACH 2



1. Farmers Investment Company Pecan Groves and Proposed Groundwater Savings Facility
2. Toro Road Potential Future Bridge Crossing
3. Bureau of Reclamation Grade Control Structure and Fish Barrier

REACH 2

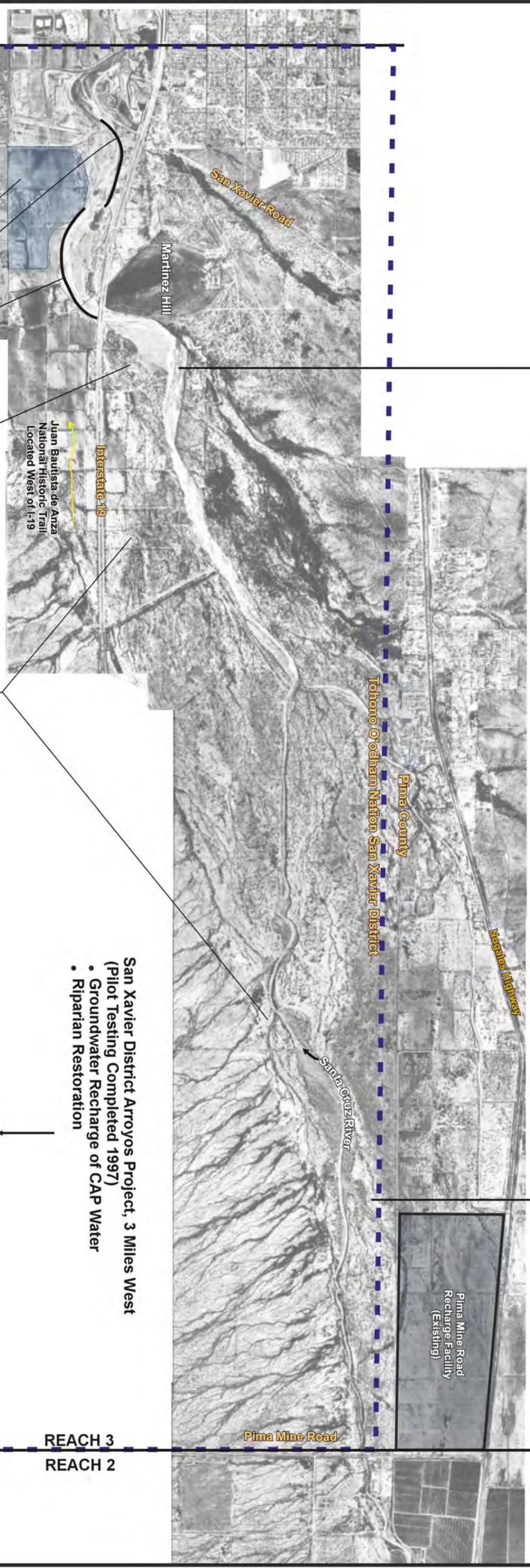
Existing Features & Proposed Projects

SANTA CRUZ RIVER

Watershed Management Study
Pima County, Arizona

FIGURE 4

Potential Location for In-Channel and Basin Recharge of Central Arizona Project Water



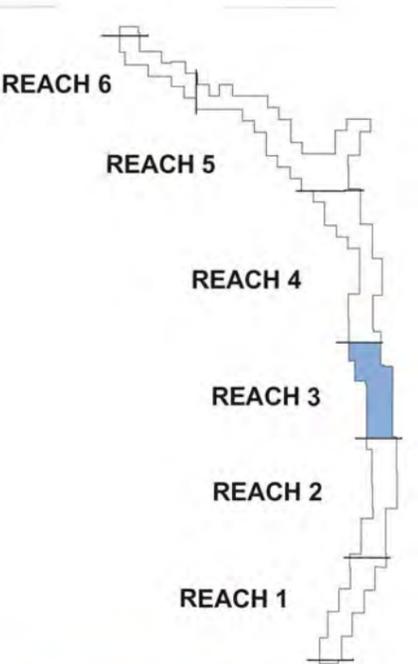
Proposed Extension Farm between I-19 and Santa Cruz River may require bank protection on west bank of river

Proposed 12-Acre Riparian Restoration Project- San Xavier District

Bureau of Reclamation Bank Protection (Existing)

Proposed Farm Rehabilitation Project

San Xavier District Arroyos Project, 3 Miles West
 (Pilot Testing Completed 1997)
 • Groundwater Recharge of CAP Water
 • Riparian Restoration



REACH 3
 Existing Features & Proposed Projects

SANTA CRUZ RIVER
 Watershed Management Study
 Pima County, Arizona

FIGURE 5

City of Tucson
 Tohono O'odham Nation
 San Xavier District

REACH 4
 REACH 3

San Xavier Mission

Martinez Hill

San Xavier Road

Juan Bautista de Anza National Historic Trail
 Located West of I-19

Interstate 19

Pima County
 Tohono O'odham Nation San Xavier District

Nogales Highway

Santa Cruz River

Pima Mine Road Recharge Facility (Existing)

Pima Mine Road

REACH 3
 REACH 2

- Rillito River and Tributaries Proposed Projects
 - Rillito River Environmental Restoration from Country Club Blvd to Swan Road, 5-7 miles east
 - Rillito River at Swan Road Wetlands, 7 miles east
 - Tanque Verde Creek from Craycroft Road to Sabino Canyon Road-Bank Protection and Environmental Restoration, 8-10 miles east
 - Agua Caliente Environmental Restoration, 12 miles east

Tucson Drainage Flood Control Project

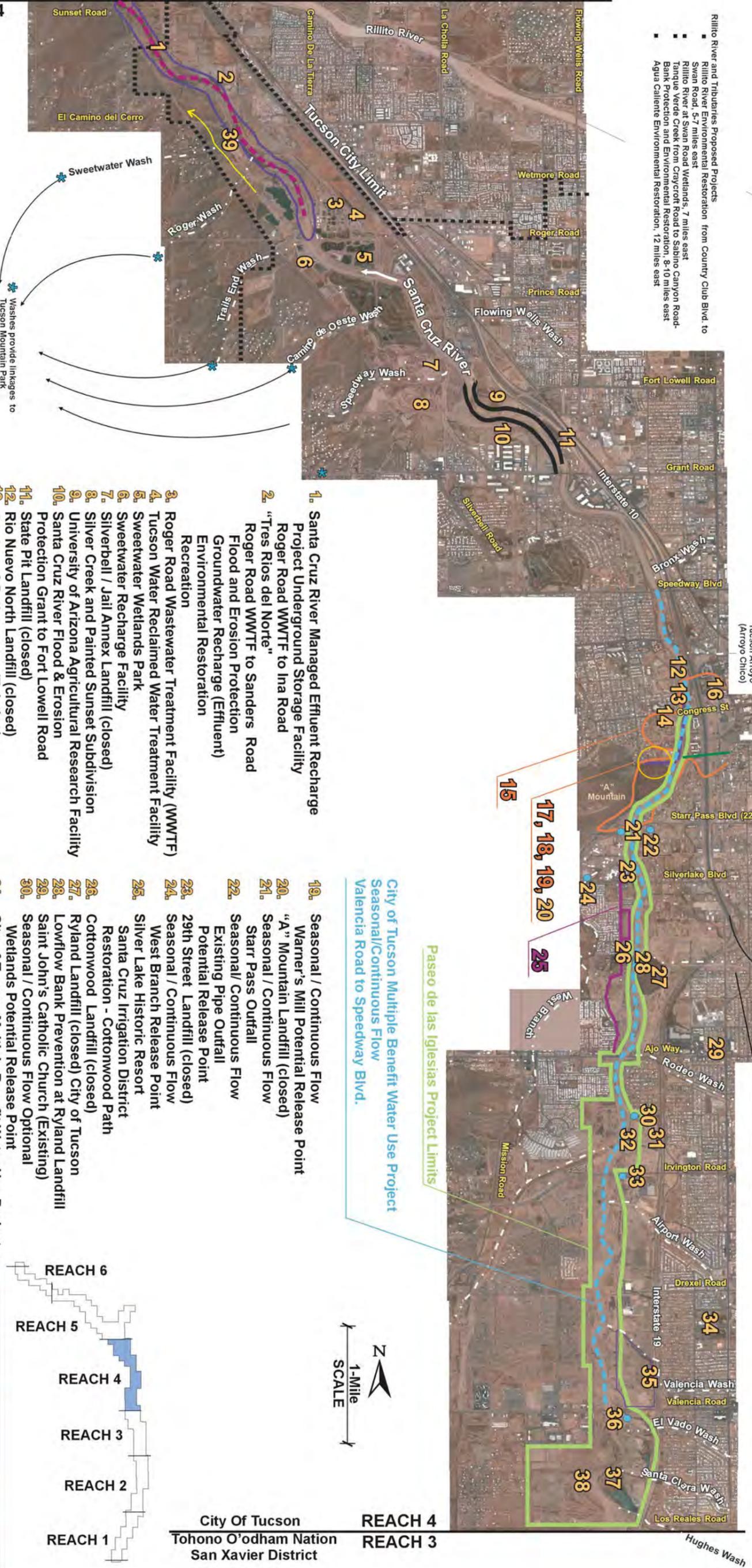
- Proposed Park Avenue Detention Basin, 2 miles east
- Randolph South Detention Basin/Dell Ulrich Golf Course, 4.5 miles east (completed 1996)

Ajo Detention Basin Environmental Restoration Project, 3 miles east (completed 2000)

Tucson Diversion Channel Bike Trail from I-19 to Ajo Detention Basin (completed 1998)

Potential to Connect Bike Trail between I-19 and Santa Cruz River

Tucson Division Channel (Julian Wash)

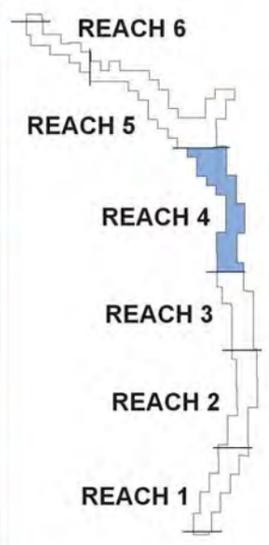


1. Santa Cruz River Managed Effluent Recharge Project Underground Storage Facility Roger Road WWTF to Ina Road
2. "Tres Rios del Norte" Roger Road WWTF to Sanders Road Flood and Erosion Protection Groundwater Recharge (Effluent) Environmental Restoration Recreation
3. Roger Road Wastewater Treatment Facility (WWTF)
4. Tucson Water Reclaimed Water Treatment Facility
5. Sweetwater Wetlands Park
6. Sweetwater Recharge Facility
7. Silverbell / Jail Annex Landfill (closed)
8. Silver Creek and Painted Sunset Subdivision
9. University of Arizona Agricultural Research Facility
10. Santa Cruz River Flood & Erosion Protection Grant to Fort Lowell Road
11. State Pit Landfill (closed)
12. Rio Nuevo North Landfill (closed)
13. Garden of Gethsemane (Existing)
14. Rio Nuevo North and South Landfill (closed)
15. City of Tucson Rio Nuevo Downtown Redevelopment Project from North of Congress Blvd to Starr Pass Blvd
16. City of Tucson-Multiple Benefit Water Use Project Downtown Gateway Water Feature
17. Mission San Agustin de Tucson
18. Convento/Mission Gardens/Warner's Mill

19. Seasonal / Continuous Flow Warner's Mill Potential Release Point
20. "A" Mountain Landfill (closed)
21. Seasonal / Continuous Flow Starr Pass Outfall
22. Seasonal/ Continuous Flow Existing Pipe Outfall Potential Release Point
23. 29th Street Landfill (closed)
24. Seasonal / Continuous Flow West Branch Release Point
25. Silver Lake Historic Resort Santa Cruz Irrigation District Restoration - Cottonwood Path
26. Cottonwood Landfill (closed)
27. Ryland Landfill (closed) City of Tucson
28. Lowflow Bank Prevention at Ryland Landfill
29. Saint John's Catholic Church (Existing)
30. Seasonal / Continuous Flow Optional Wetlands Potential Release Point
31. City of Tucson Multiple Benefit Water Use Project Santa Cruz River Park Extension
32. Tucson Airport Remediation Project (TARP) Groundwater Treatment Plant (Existing)
33. Seasonal / Continuous Flow
34. Santa Cruz River Park Potential Release Point
35. Mission Park (Existing)
36. Hohokan Archaeological Interpretive Site
37. Seasonal / Continuous Flow San Xavier Potential Release Point
38. Wetlands at Valencia
39. Native Seed Traditional Flood Irrigation Farming Juan Bautista de Anza National Historic Trail Between Santa Cruz River and Silverbell Road

City of Tucson Multiple Benefit Water Use Project Seasonal/Continuous Flow Valencia Road to Speedway Blvd.

Paseo de las Iglesias Project Limits



REACH 4

Existing Features & Proposed Projects

SANTA CRUZ RIVER

Watershed Management Study

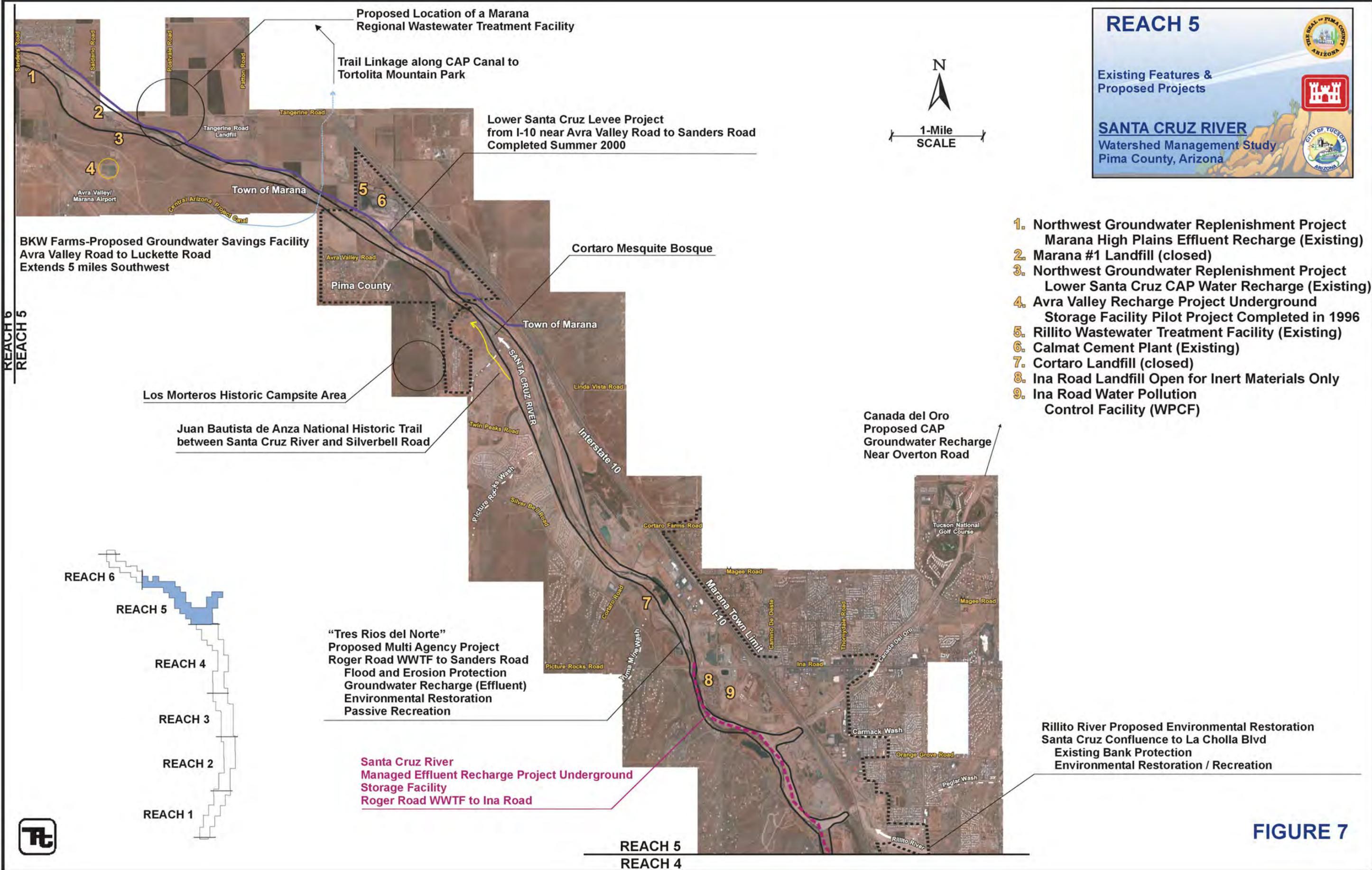
Pima County, Arizona



REACH 5
REACH 4

FIGURE 6

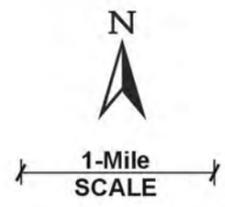
City Of Tucson
Tohono O'odham Nation
San Xavier District



Proposed Location of a Marana Regional Wastewater Treatment Facility

Trail Linkage along CAP Canal to Tortolita Mountain Park

Lower Santa Cruz Levee Project from I-10 near Avra Valley Road to Sanders Road Completed Summer 2000



BKW Farms-Proposed Groundwater Savings Facility Avra Valley Road to Luckette Road Extends 5 miles Southwest

Cortaro Mesquite Bosque

Los Morteros Historic Campsite Area

Juan Bautista de Anza National Historic Trail between Santa Cruz River and Silverbell Road

Canada del Oro Proposed CAP Groundwater Recharge Near Overton Road

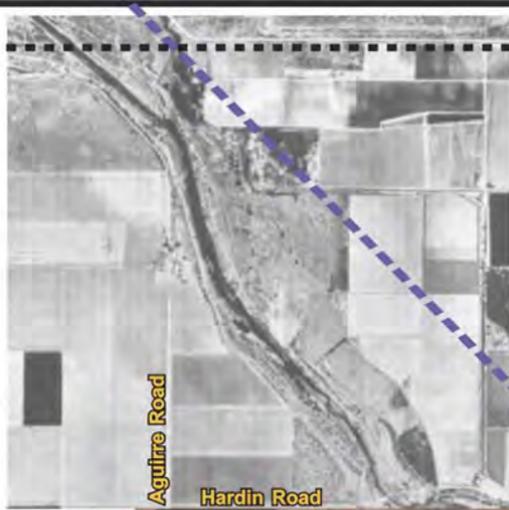
"Tres Rios del Norte" Proposed Multi Agency Project Roger Road WWTF to Sanders Road Flood and Erosion Protection Groundwater Recharge (Effluent) Environmental Restoration Passive Recreation

Santa Cruz River Managed Effluent Recharge Project Underground Storage Facility Roger Road WWTF to Ina Road

Rillito River Proposed Environmental Restoration Santa Cruz Confluence to La Cholla Blvd Existing Bank Protection Environmental Restoration / Recreation



Pinal County
Pima County



Cortaro-Marana Irrigation District
Proposed Groundwater Savings Facility
Tangerine Road to Trico Road
Between Santa Cruz River and Interstate-10

Existing Marana Wastewater Treatment Plant

Berry Acres Subdivision
Proposed Flood Control & Erosion Control

Lower Santa Cruz Levee Project
Proposed Alignment for Phases II & III
From Sanders Road to Pinal County Line



Pima County
Marana Town Limit

Luckette Road

Wentz Road

Trico Marana Road

Sanders Road

Moore Road

Pima County
Marana Town Limit

BKW Farms-Proposed Groundwater Savings Facility
Avra Valley Road to Luckette Road
Extends 5 miles Southwest

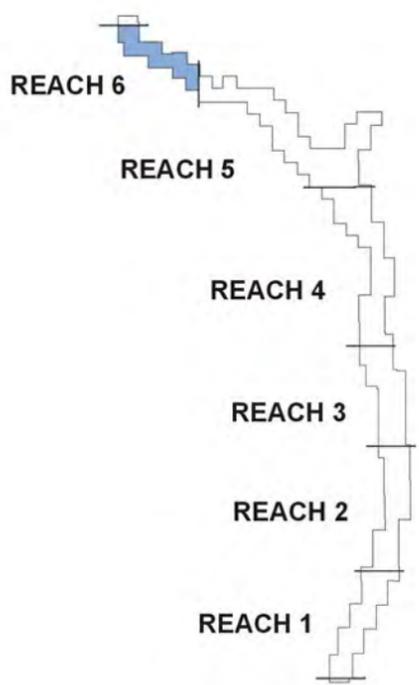
REACH 6

Existing Features &
Proposed Projects

SANTA CRUZ RIVER
Watershed Management Study
Pima County, Arizona



Juan Bautista de Anza National
Historic Trail between Santa Cruz
River and Silver Bell Road

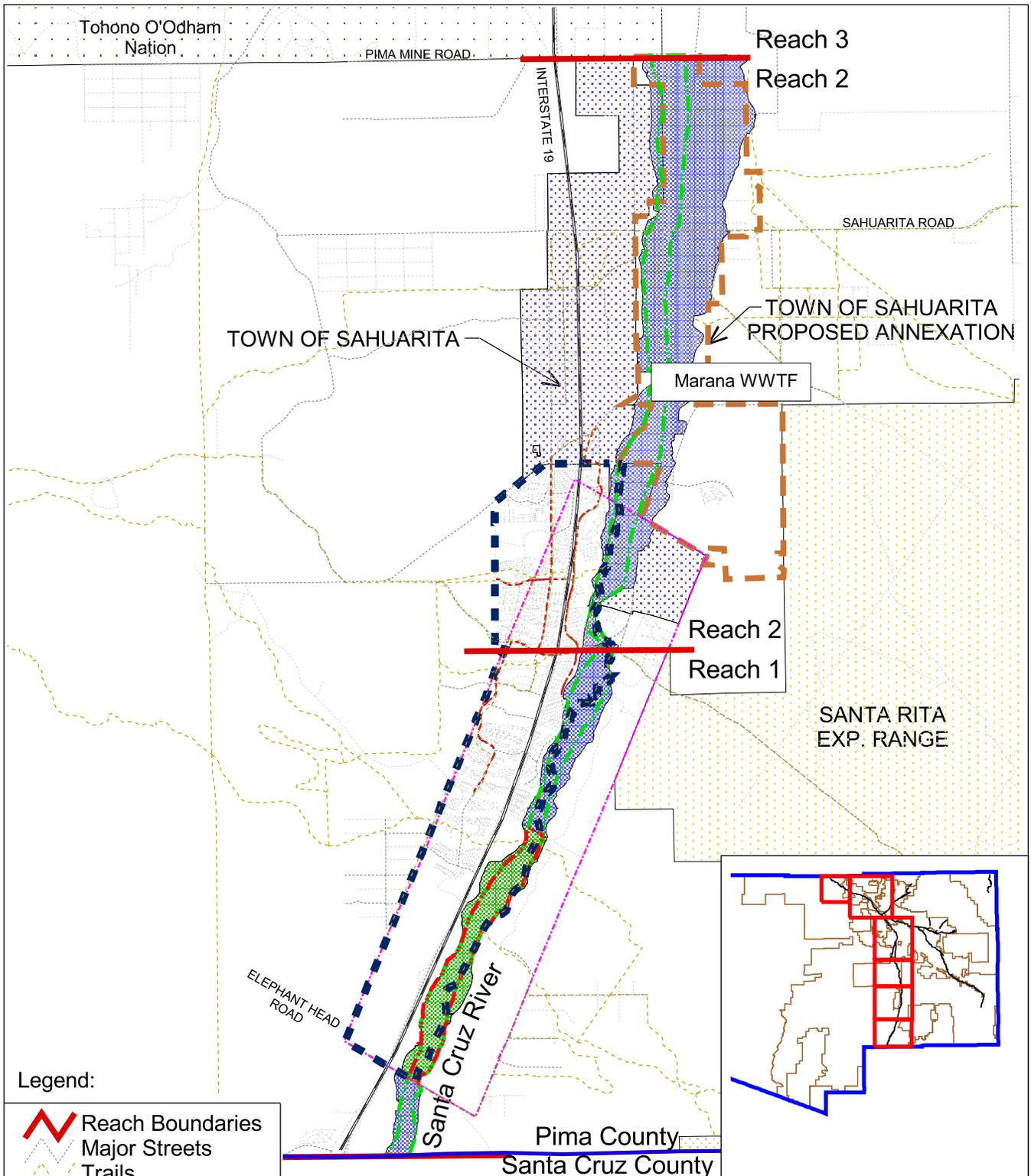


1-Mile
SCALE

REACH 6
REACH 5



FIGURE 8



Legend:

-  Reach Boundaries
-  Major Streets
-  Trails
-  Bike Routes
-  Green Valley Planning Area
-  Canoa Land Grant
-  Canoa Ranch Floodway
-  Santa Cruz River Floodway
-  Minor Streets
-  Canoa Ranch Floodplain
-  Santa Cruz River Floodplain



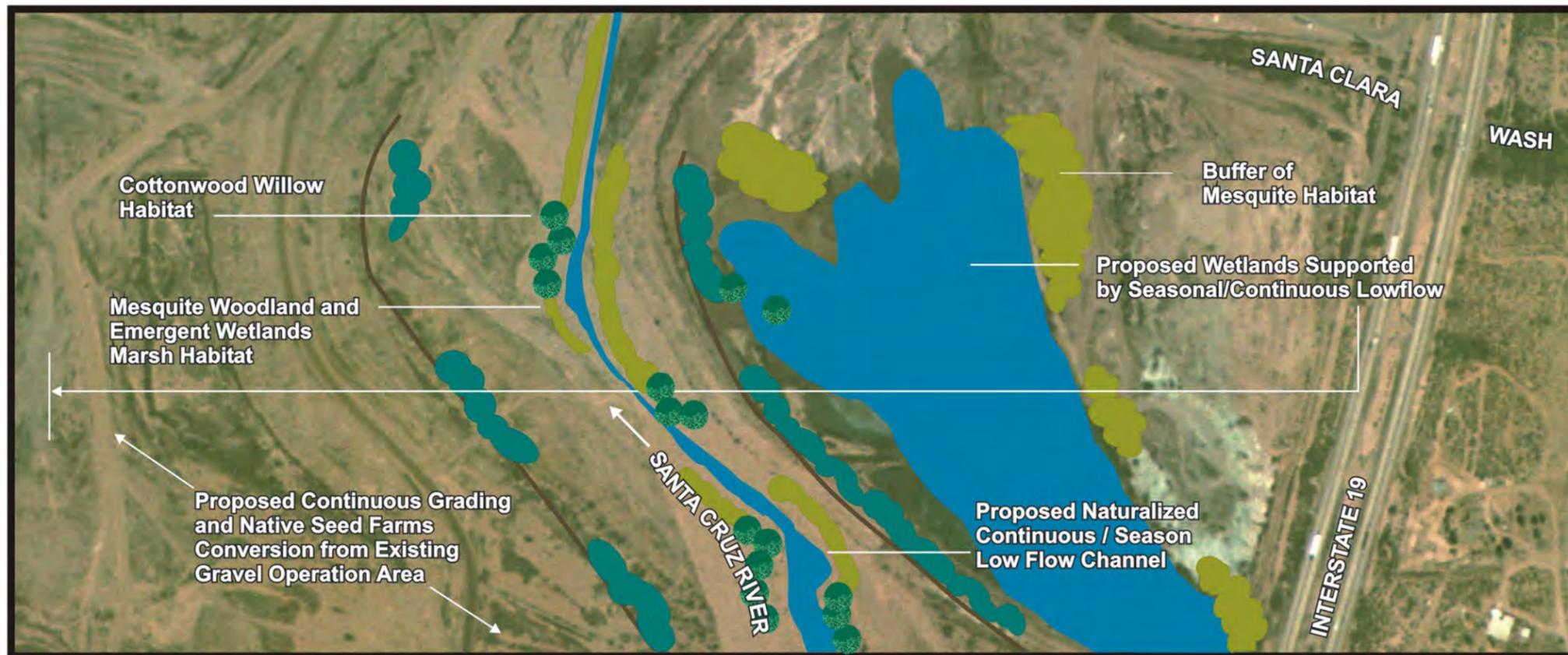
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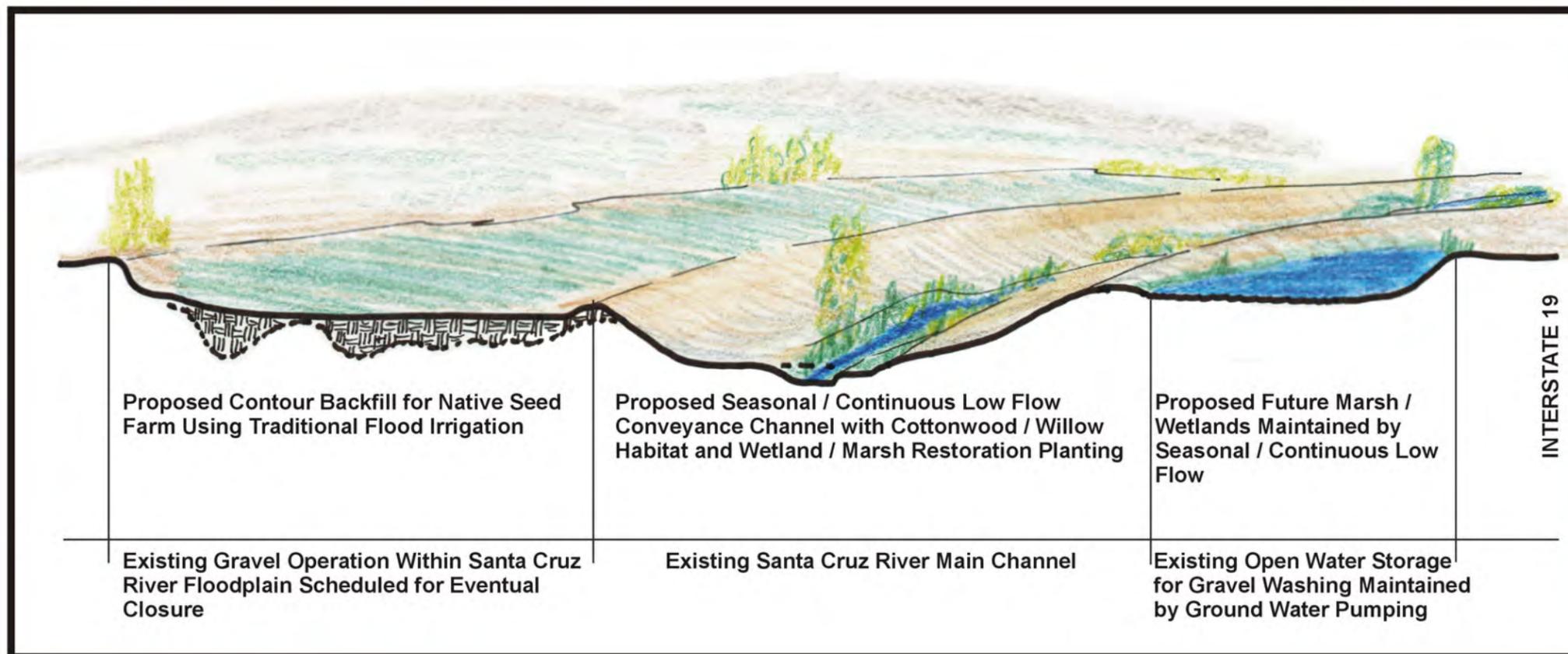
**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**

Floodprone Land Acquisition

Figure 9



SEASONAL FLOW FACILITY/WETLANDS



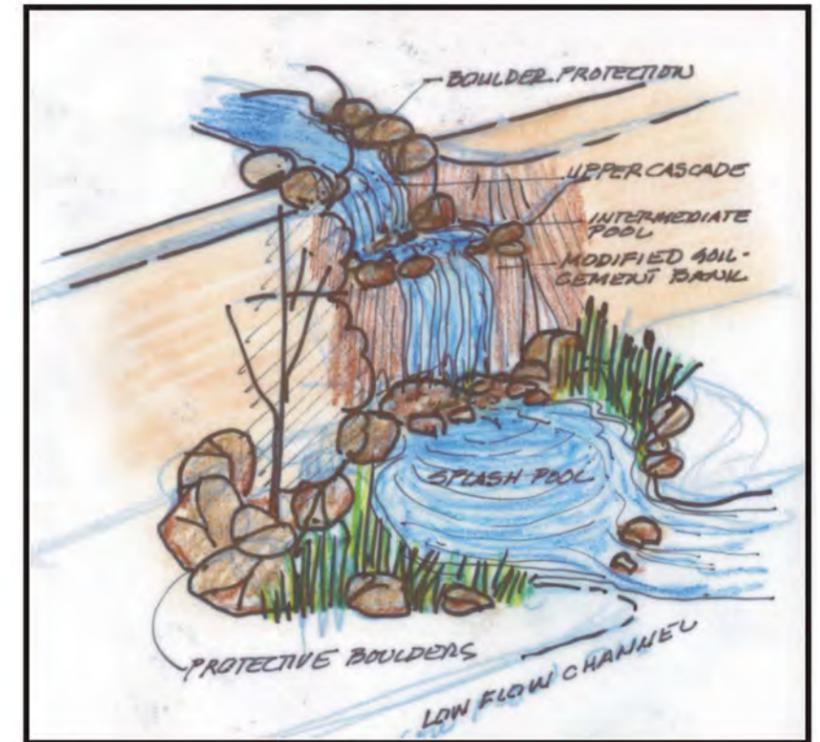
ILLUSTRATIVE SECTION

FIGURE 10
Seasonal / Continuous Flow & Wetlands at Valencia
Pima County/USACE
Paseo de las Iglesias
City of Tucson
Multiple Benefit Water Project

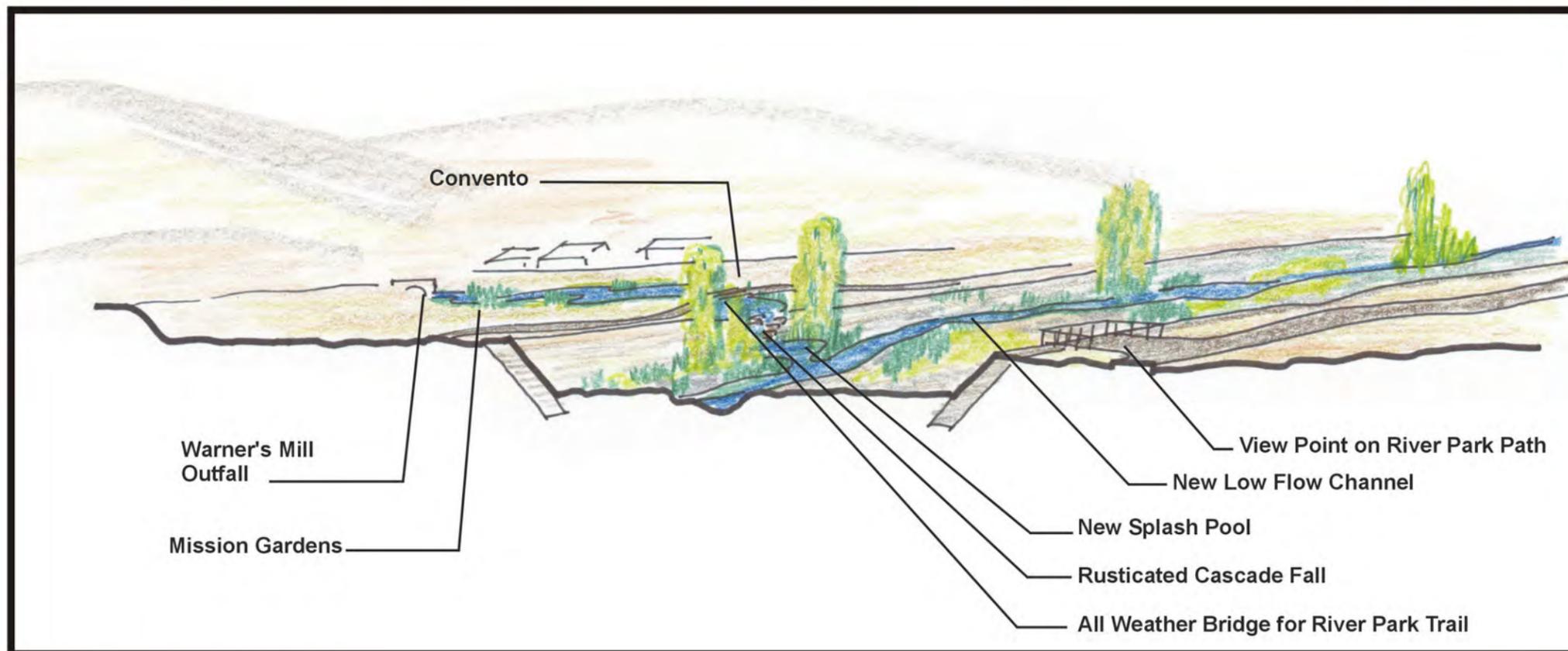




SEASONAL/CONTINUOUS FLOW FACILITY, CULTURAL RESTORATION



SPLASH POOL CONCEPT



ILLUSTRATIVE SECTION

FIGURE 11

Seasonal / Continuous Flow & Cultural Restoration

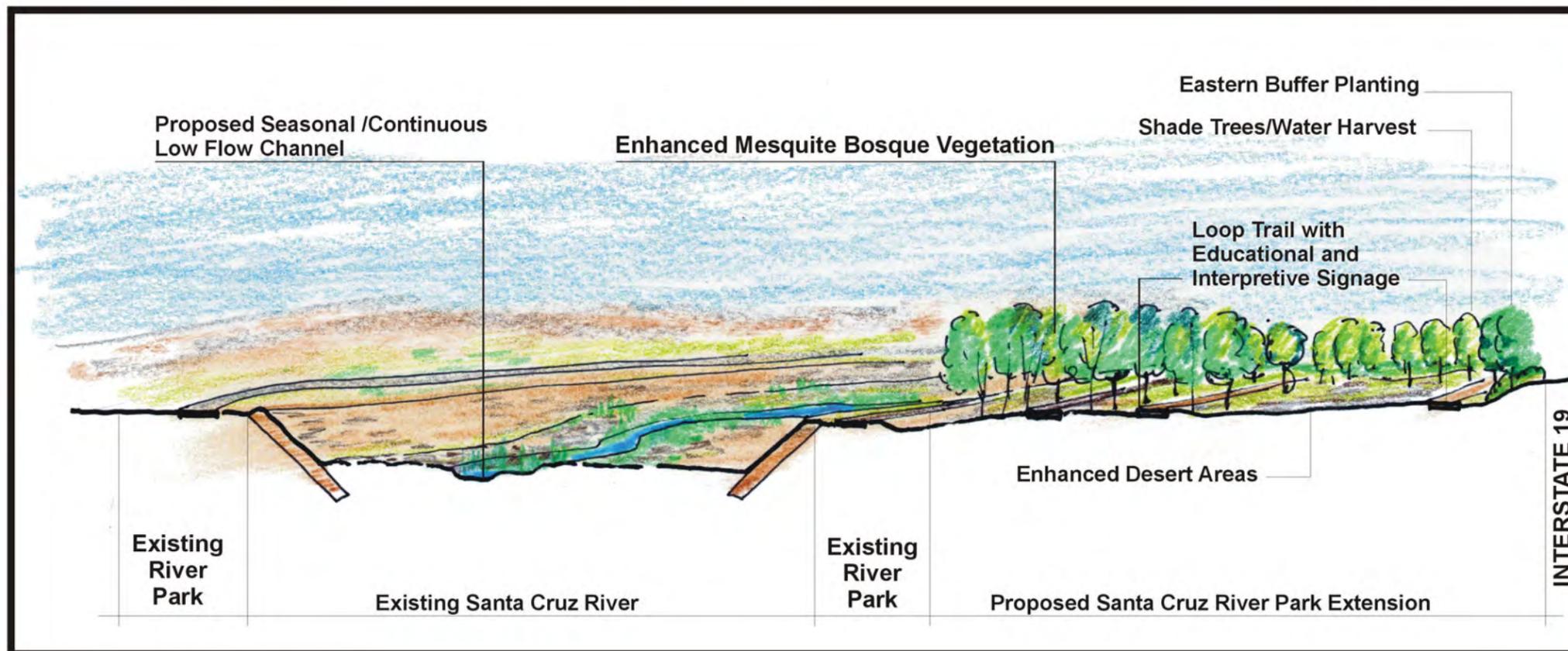
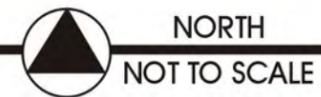
Pima County/USACE
Paseo de las Iglesias

City of Tucson
Multiple Benefit Water Project
Rio Nuevo





SEASONAL FLOW FACILITY/RIVER PARK EXTENSION



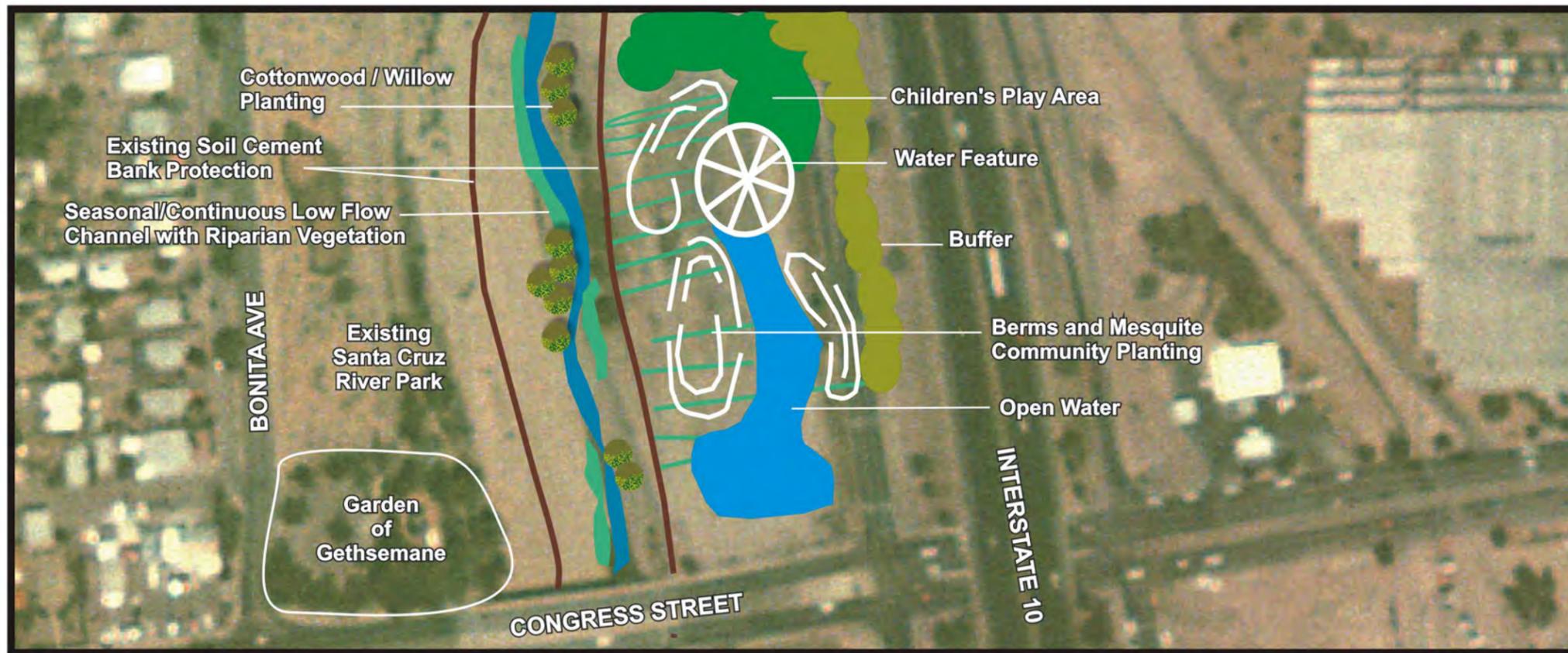
ILLUSTRATIVE SECTION

FIGURE 12

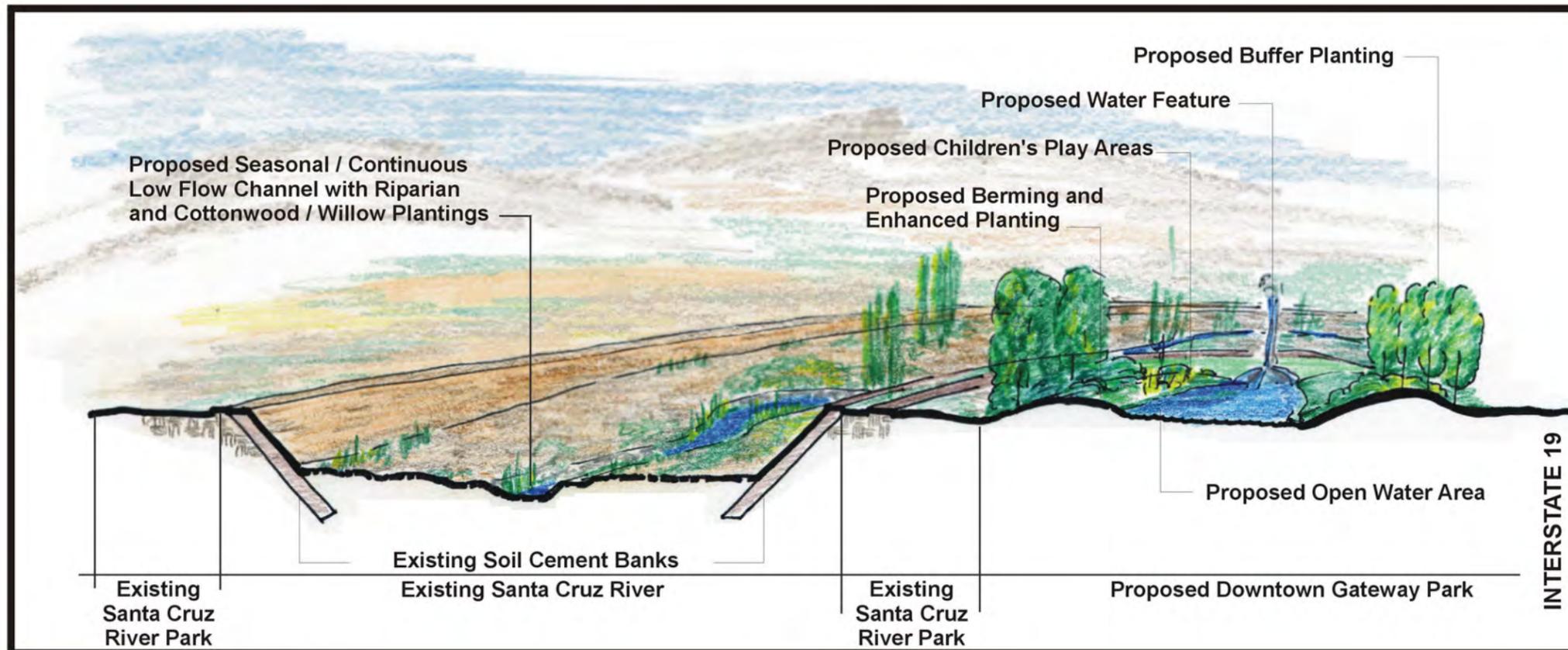
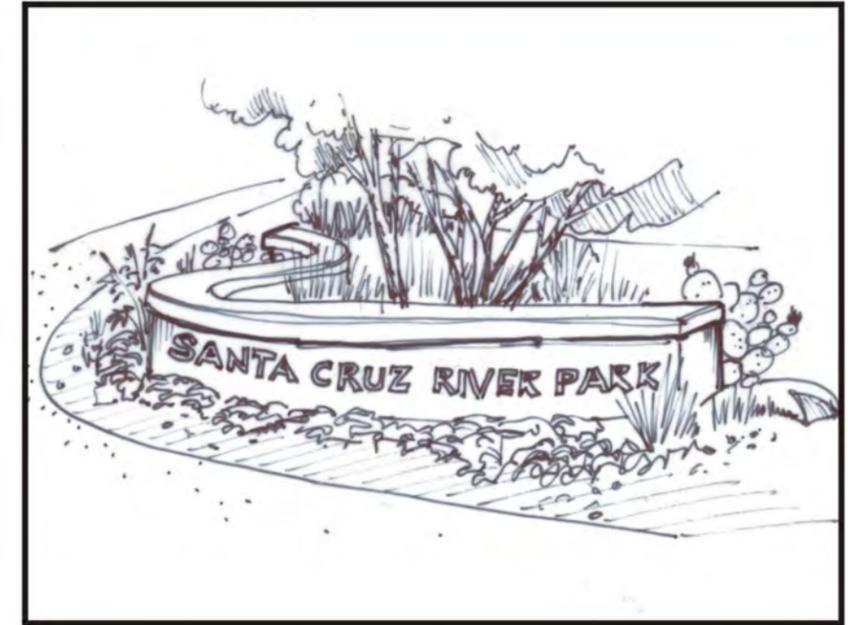
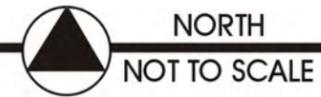
Seasonal / Continuous Flow & Santa Cruz River Park Extension

City of Tucson
Multiple Benefit Water Project





SEASONAL FLOW FACILITY / DOWNTOWN GATEWAY PLAN



ILLUSTRATIVE SECTION

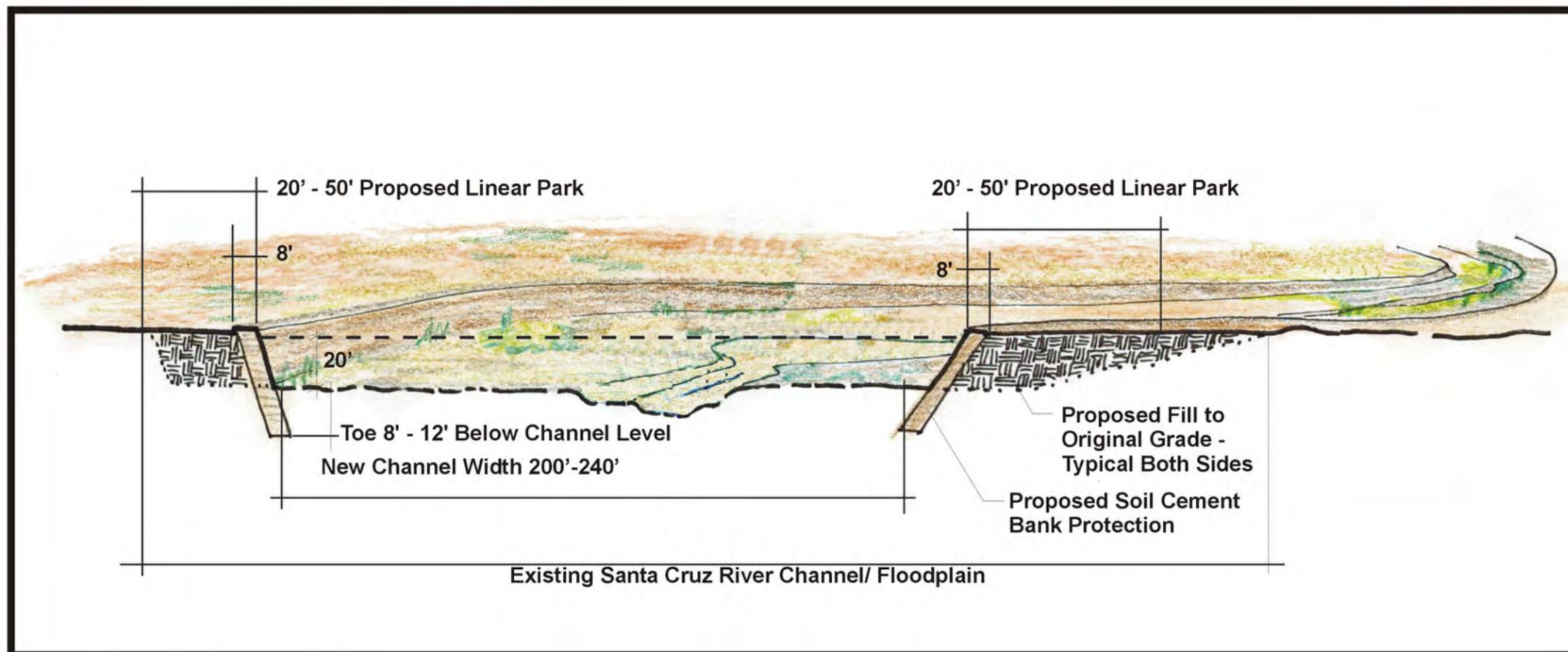
FIGURE 13
Seasonal / Continuous Flow & Downtown Gateway Park

City of Tucson
 Multiple Benefit
 Water Project





PROPOSED BANK PROTECTION



ILLUSTRATIVE SECTION

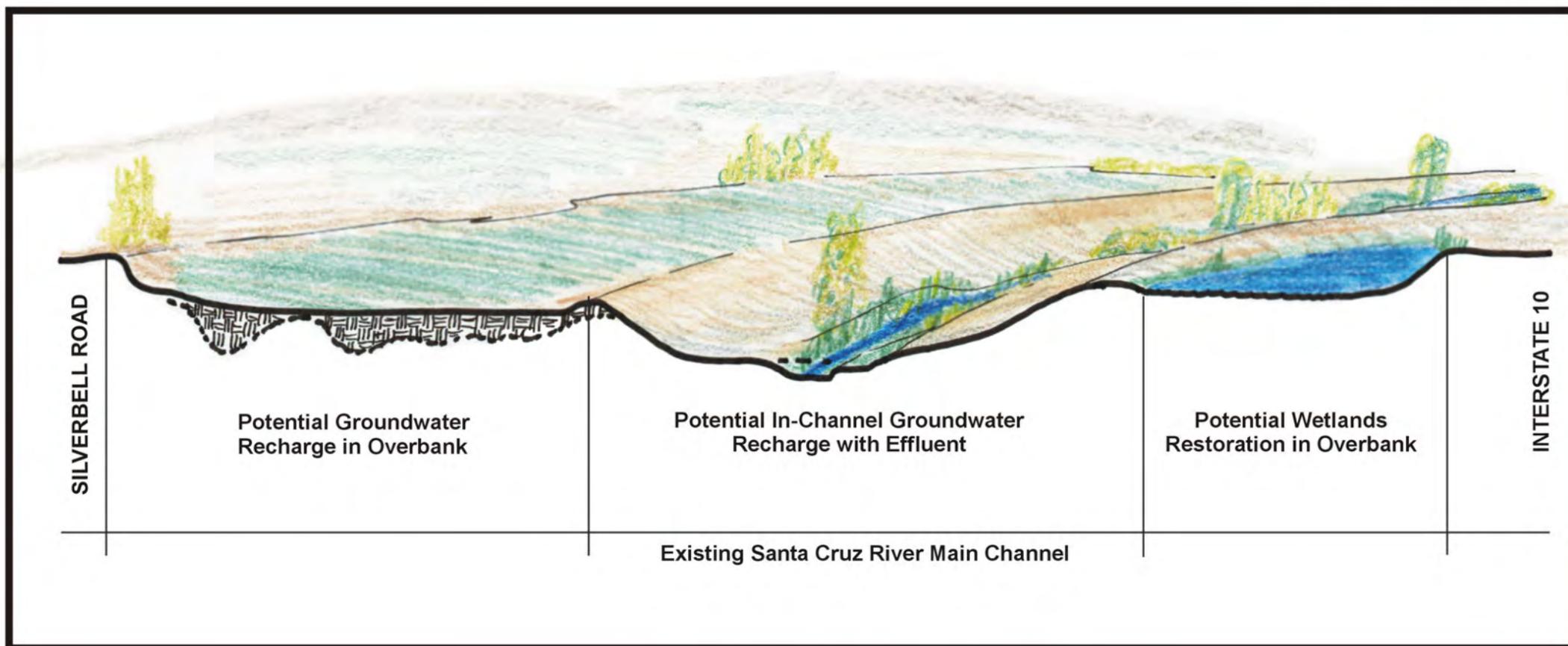
FIGURE 14
 Grant Road to Fort Lowell
 Bank Protection

Pima County





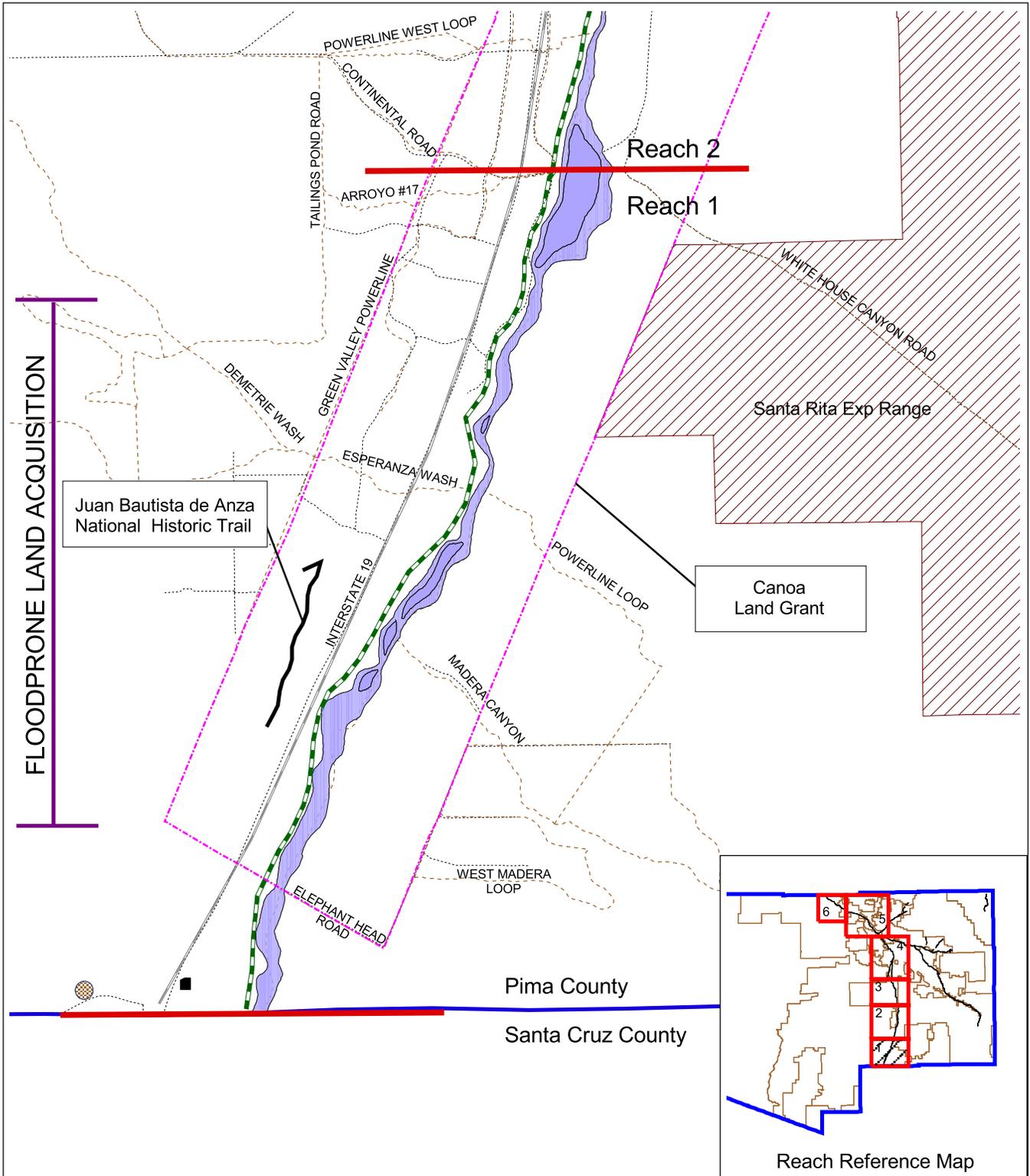
GROUNDWATER RECHARGE/WETLANDS



ILLUSTRATIVE SECTION

FIGURE 15
Environmental Restoration and Groundwater Recharge
 Pima County/USACE
 City of Tucson/Town of Marana
 Tres Rios del Norte





Legend:

- | | |
|--|---|
|  Reach Boundary |  City/County Parks |
|  Major Washes |  Existing Riverparks |
|  Major Roads |  Proposed River Parks |
|  Trails |  Proposed River Paths |
|  Federal Parks |  Proposed River Trails |



Scale: 1" = 8,000 ft

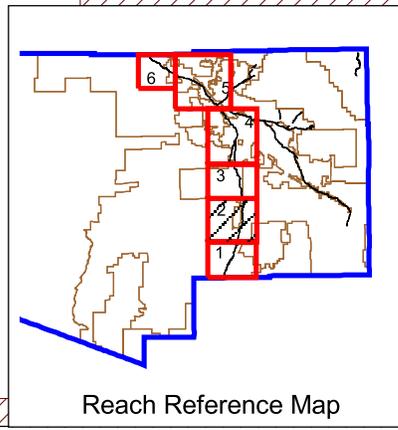
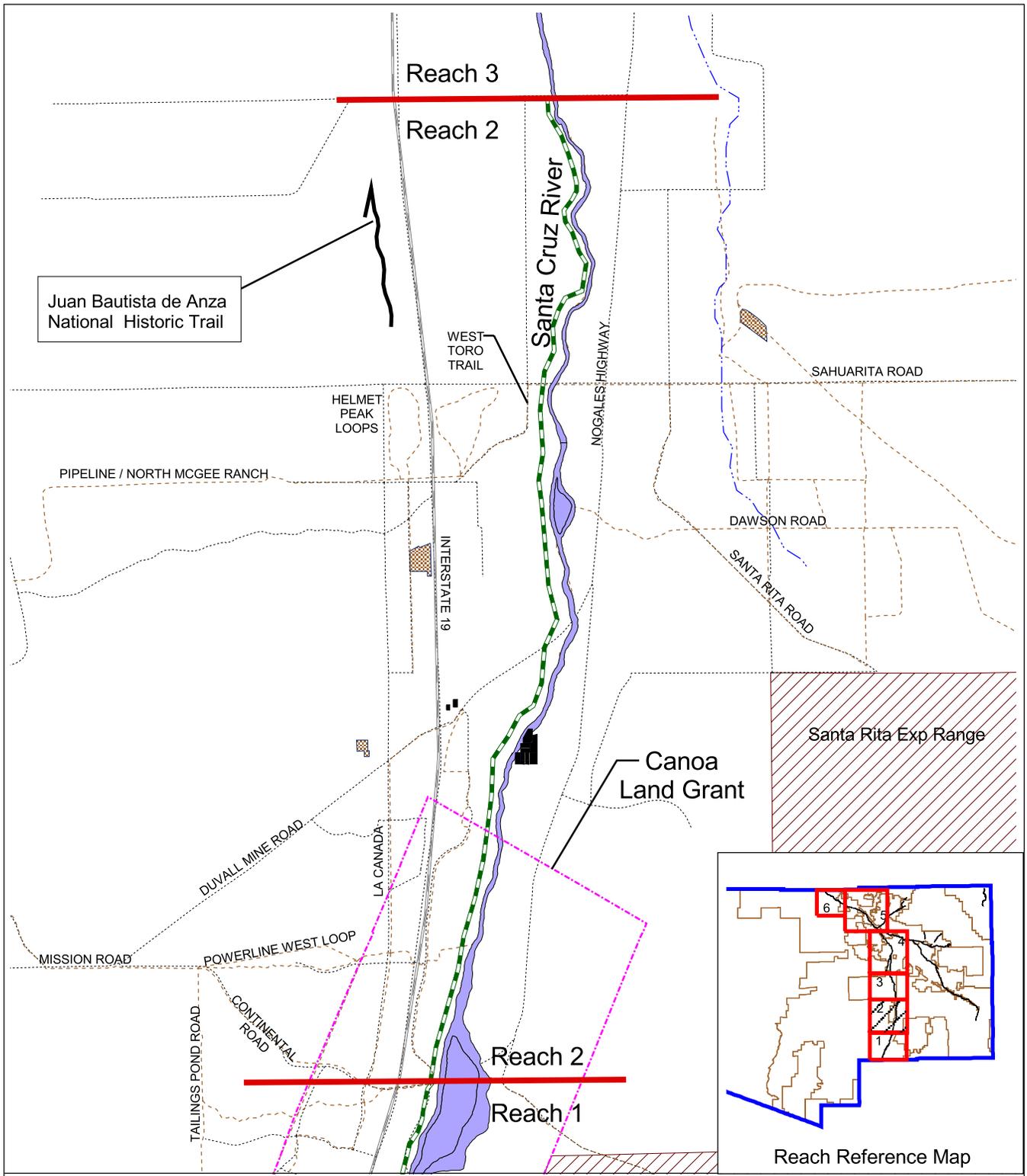
8000 0 8000 Feet

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Feasibility Phase Study**

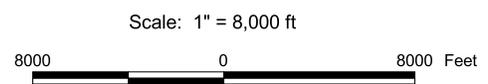
Uplands Concepts- Reach 1

Figure 16





- Legend:**
- Reach Boundary
 - ~ Major Washes
 - Major Roads
 - Trails
 - / / / Federal Parks
 - City/County Parks
 - - - Existing Riverparks
 - - - Proposed River Parks
 - ~ Proposed River Paths
 - - - Proposed River Trails

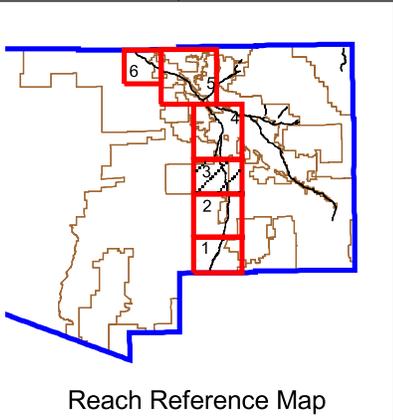
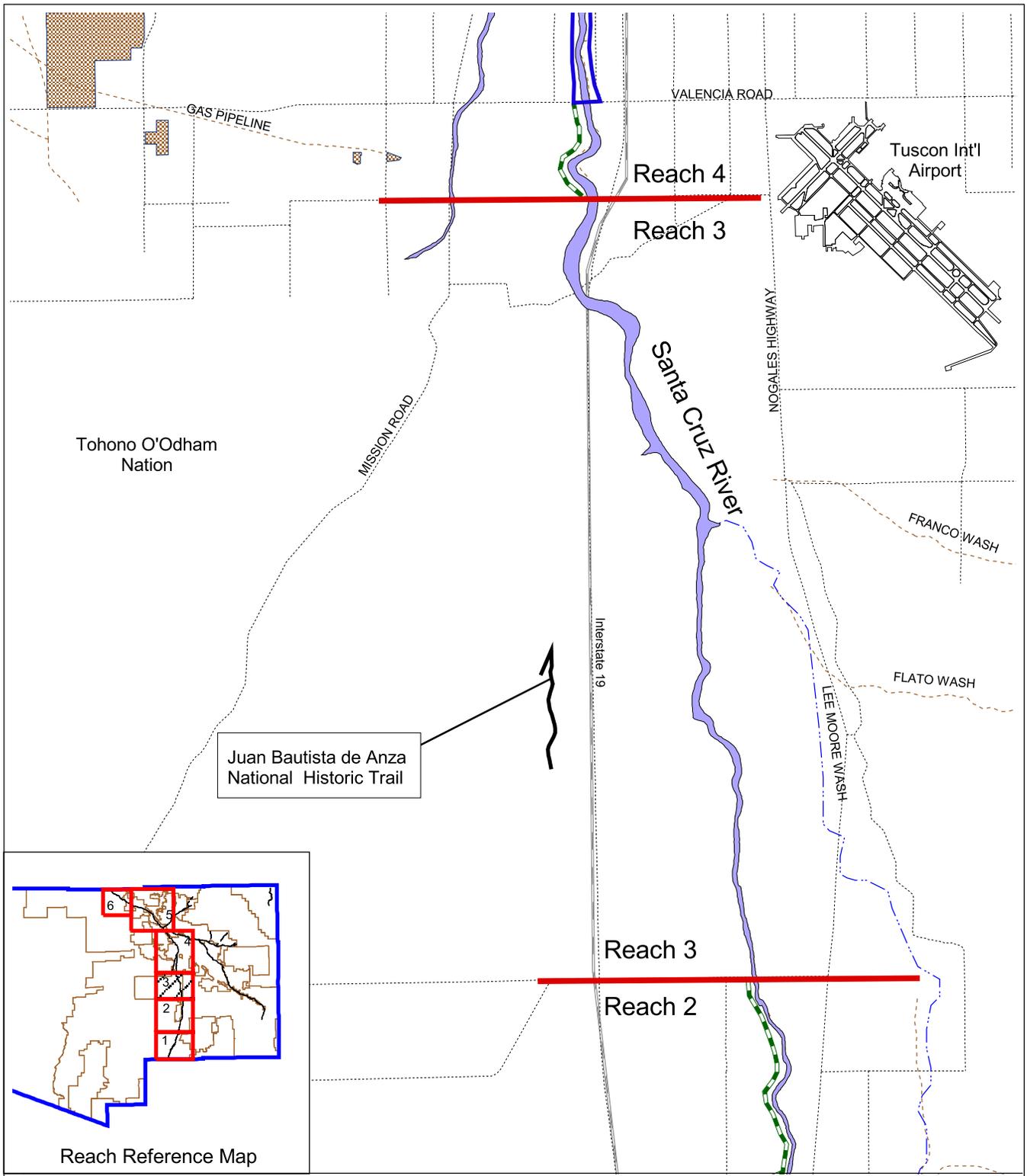


**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**



Uplands Concept- Reach 2

Figure 17



- Legend:**
- Reach Boundary
 - ~ Major Washes
 - Major Roads
 - - - Trails
 - Tt Federal Parks
 - City/County Parks
 - - - Existing Riverparks
 - - - Proposed River Parks
 - ~ Proposed River Paths
 - - - Proposed River Trails



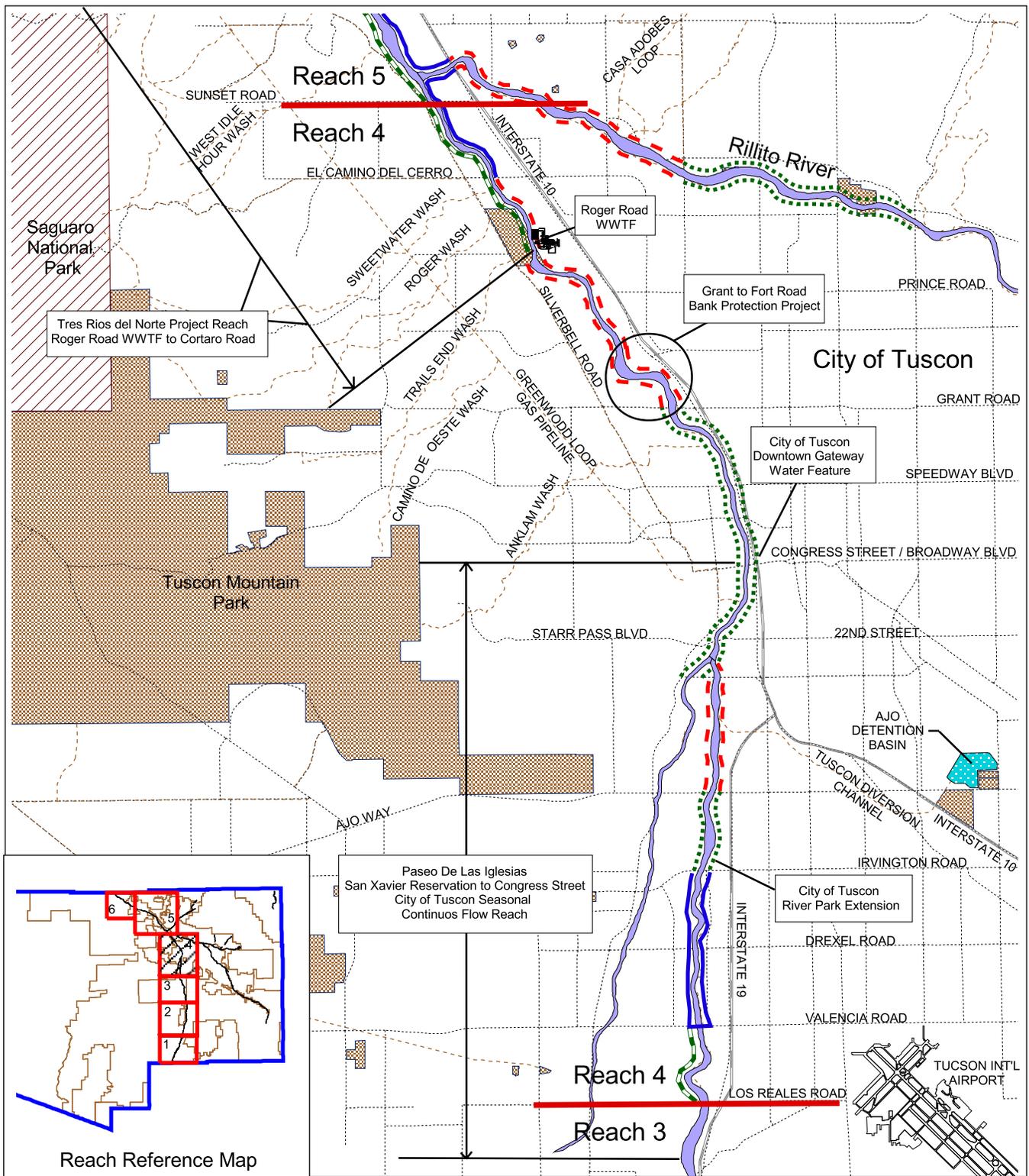
Scale: 1" = 8,000 ft

8000 0 8000 Feet

**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**

Uplands Concept- Reach 3

Figure 18



Legend:

- Reach Boundary
- Major Washes
- Major Roads
- Trails
- Federal Parks
- City/County Parks
- Existing Riverparks
- Proposed River Parks
- Proposed River Paths
- Proposed River Trails



Scale: 1" = 10,000 ft

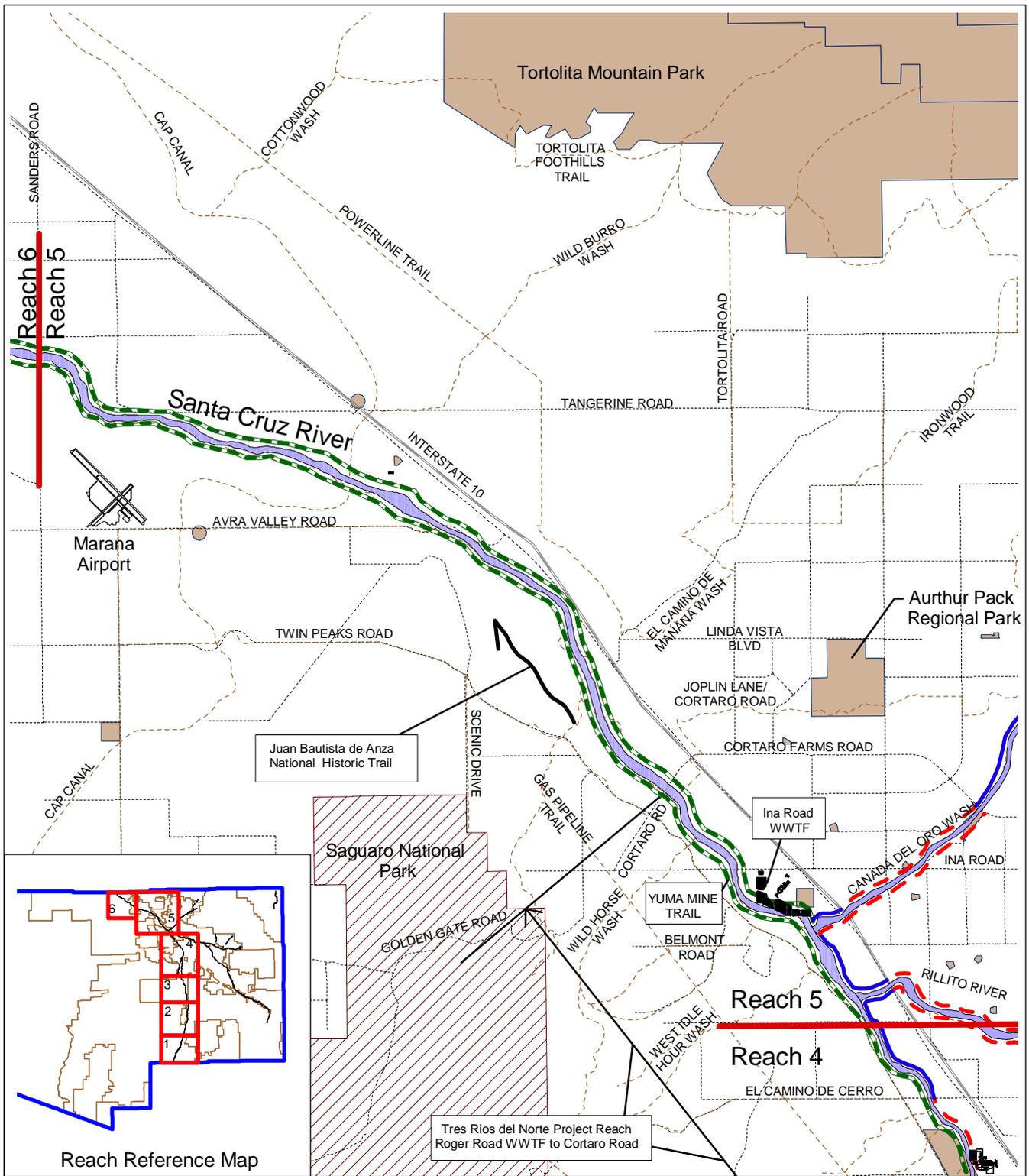


**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**

Uplands Concept- Reach 4

Figure 19





Legend:

- | | |
|--|---|
|  Reach Boundary |  City/County Parks |
|  Major Washes |  Existing Riverparks |
|  Major Roads |  Proposed River Parks |
|  Trails |  Proposed River Paths |
|  Federal Parks |  Proposed River Trails |



Scale: 1" = 10,000 ft

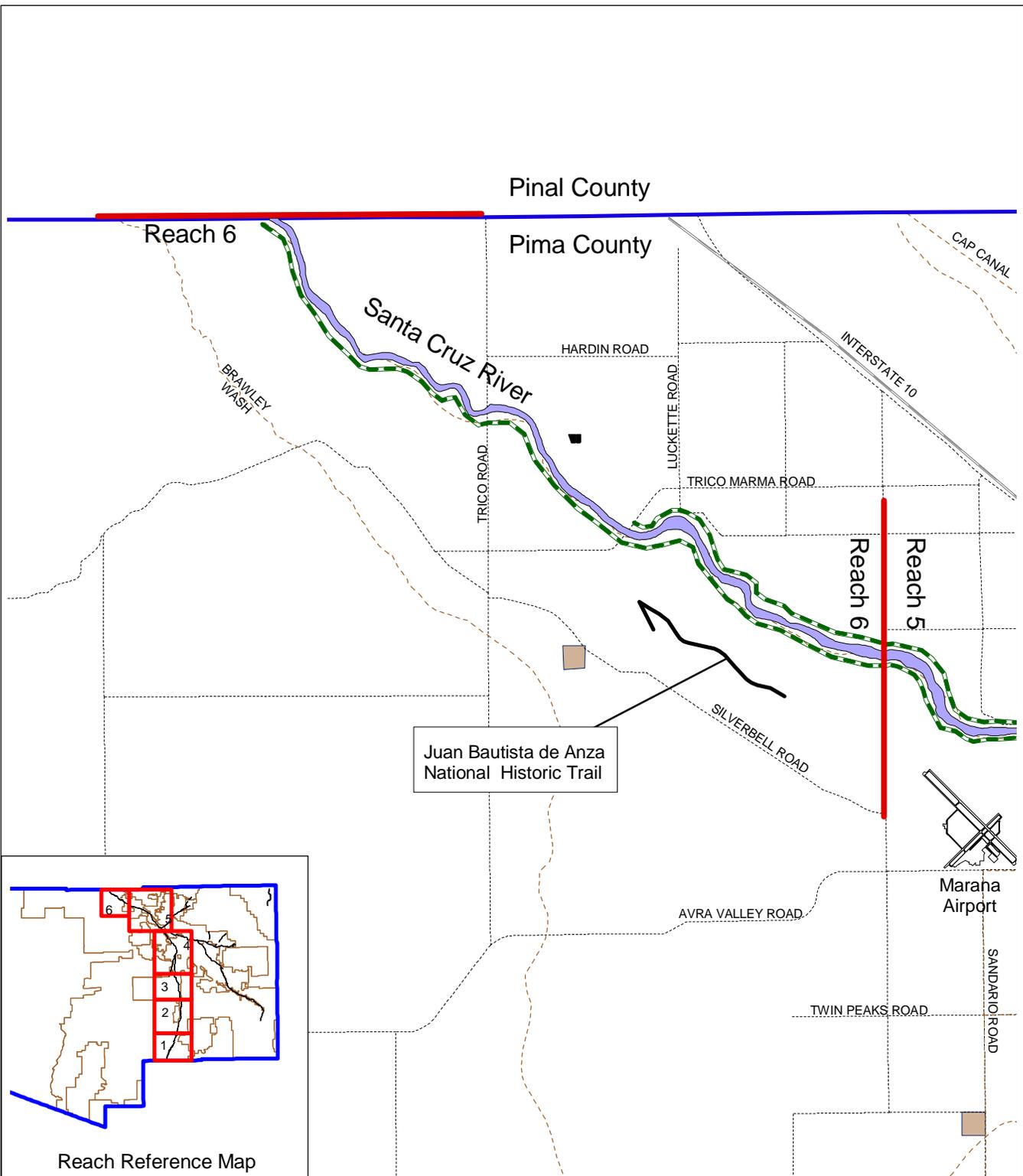


**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**

Uplands Concept- Reach 5

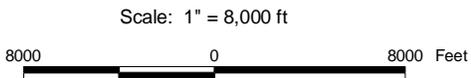
Figure 20





Legend:

- Reach Boundary
- Major Washes
- Major Roads
- Trails
- Federal Parks
- City/County Parks
- Existing Riverparks
- Proposed River Parks
- Proposed River Paths
- Proposed River Trails



**Santa Cruz River Watershed Basin, Pima County, Arizona
Feasibility Phase Study**

Uplands Concept- Reach 6

Figure 21

