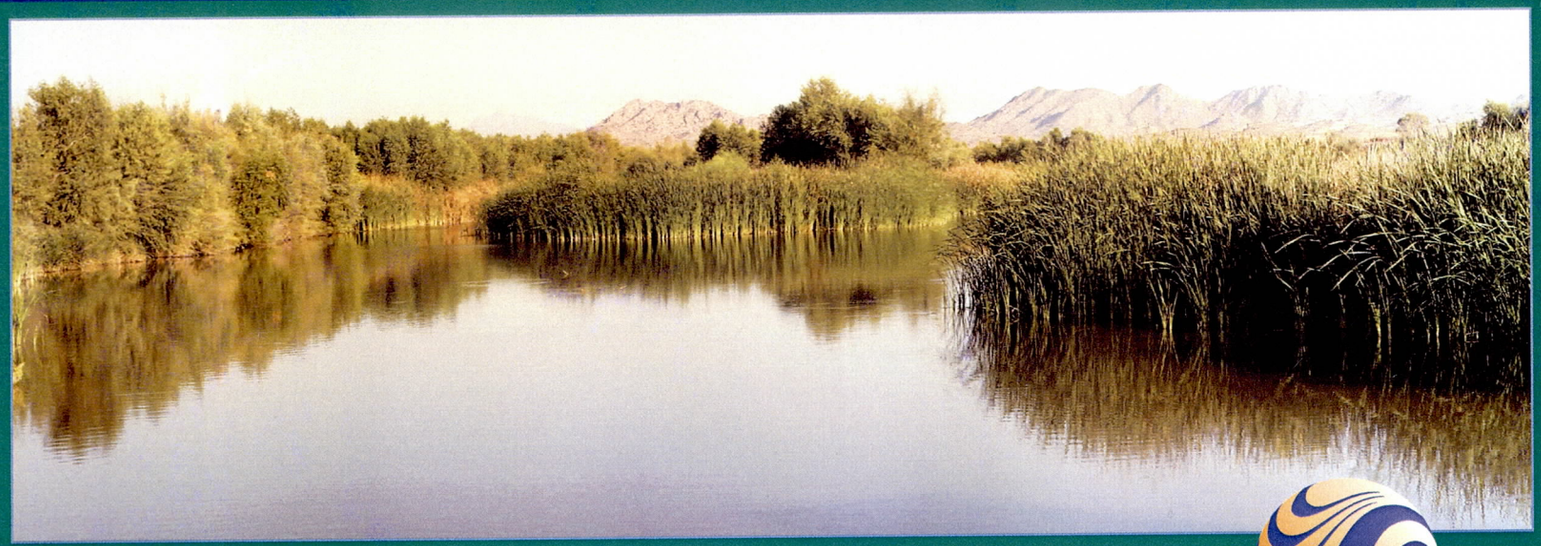
DATA COLLECTION REPORT

El Rio Watercourse Master Plan and Area Drainage Master Plan

Contract FCD 2001C024
Stantec Project No. 82000240



Stantec

December 2002
Revised September 2003
Final Revision September 2005

FINAL REPORT

El Rio Watercourse Master Plan

Data Collection Report

PREPARED FOR:

FLOOD CONTROL DISTRICT
of
Maricopa County

PREPARED BY:

STANTEC CONSULTING INC.
8211 South 48th Street
Phoenix, Arizona 85044
(602) 438-2200

September 2005
Revised September 12, 2003
STANTEC CONSULTING Inc.
Project No. 8200240

Contract FCD 2001C024

Stantec

TABLE OF CONTENTS

Page

Registered Professional Engineer (Civil) CERTIFICATE NO. 31680 PATRICK J. ELLISON Date Signed 9/19/08 ARIZONA U.S.A.

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

DATA COLLECTION

The data collection task for the El Rio Watercourse Master Plan (El Rio Project) consists of collecting information that will be pertinent to define Engineering, Environmental, Ecological, Cultural/Historical and Land Uses criteria and assumptions that will be used to define natural and historic resources and project design elements and constraints. Types of information collected and reviewed includes, historical photographs (some depicting flooding), environmental surveys, current land use plans, general and area specific planning documents, vegetation, wildlife and cultural resources surveys; geologic and geomorphic data; hydraulic and hydrologic reports for floodplain delineation, existing topographic mapping, historical flooding information, as-built plans for existing structures, FEMA Flood Hazard Boundary Maps, floodplain delineation work maps, drainage reports and site plans for proposed development, drainage improvement plans; park and recreation plans; transportation, trails, and utility plans; flood control facilities design guidelines and drainage manuals.

MAPPING

Topographic mapping utilized for the El Rio Project was obtained from a number of sources. The following summary lists topographic data utilized for this study:

United States Geological Survey (USGS) 7.5 Minute Quadrangle Maps:

- Buckeye: Revised in 1971, Photo Inspected in 1978 20-foot contour interval (CI), National Geodetic Vertical Datum (NGVD) of 1929.
- Perryville: Published 1971, photo revised 1982, 20-foot CI, NGVD of 1929.
- Avondale SW: Published 1971, 20-foot CI, NGVD of 1929.
- Avondale SE: Published 1971, 20-foot CI, NGVD of 1929.
- Tolleson : Published 1974, 20-foot CI, NGVD of 1929.

United States Geological Survey (USGS) 15 Minute Quadrangle Maps:

- USGS, 15 Minute Quad, Buckeye, Arizona, 1958. Compiled in 1962 from 1:24000-scale mps dated 1957-58. (From ASU Map Room)
- USGS, 15 Minute Quad, Avondale, Arizona, 1948. (From ASU Map Room)

Detailed mapping prepared for the Flood Delineation Study of Salt-Gila Rivers FCD Contract No's 90-59 & 92-01, aerial photography flight dates are 1993. Mapping scale is 1 inch = 400 feet with a contour interval of 4 feet.

REFERENCE DOCUMENTS

A listing of reference material collected for the project is provided as Attachment 1. The listing includes owner of the document (U.S. Flood Control District of Maricopa County, Army Corps of Engineers, etc.), date of document, title of document, author, primary project discipline that would be interested in the document (Engineering, Environmental etc.) and the location (team member who collected the data) of the document for the term of the project.

AERIAL/SATELLITE PHOTOGRAPHY

Table 1 list a summary of aerial/satellite photography that has been collected. Included in the summary is the flight date, source, use (if known) and the depository location of the photography for the term of the project. The Aerials Express photography is a proprietary data set that has been purchased by Stantec Consulting Inc. (Stantec).

Table 1

Project Photography Summary

Flight Date	Source	Use	Location	Comments
Jan. 2002	Landata/FCDMC		Stantec	1 foot pixel – 1:2,400 Black and White
2002	Aerials Express		Stantec	Color – 2.3 foot pixel
Jan 2001 ?	Satellite Imagery Cooper Aerial	Vegetation Mapping and Wildlife Habitat evaluation	Stantec	Near Infra Red color
30 Apr. 1997 26 June 1997	USGS		JE Fuller	1:40,000 - Black and White
26-27 June 1993 1 July 1993	USGS		JE Fuller	1:16,400 - Black and White
2 Mar. 1993	Landiscore		Stantec	Black and White
22 Feb. 1993	Aerial Mapping Co.	USACE Jurisdictional Delineation (?)	Stantec	Black and White
2 Feb. 1993		Baker FDS (Post Flood)	Stantec	Black and White
23 Feb. thru' 28 Sept. 1992	USGS		JE Fuller	1 meter pixel – 1:40,000 Black and White (DOQ)
15 Oct. 1991	MCDOT		FCDMC	
7 June 1991	USGS		JE Fuller	1:16,000 – Black and White
1991	McLain Harbors (?)	Baker FDS (Preflood) (?)	Stantec	Black and White
22 Oct. 1990	USGS		JE Fuller	1:16,000 – Black and White
22 June 1989	Unknown		FCDMC	
22 Mar. 1985 20 Nov. 1986	Aerial Mapping Co.	Dames & Moore FDS (?)	JE Fuller	1:31,680 - Black and White
3 Mar 1985	MCDOT		FCDMC	
1 Jan. 1985	MCDOT		FCDMC	
1983	Aerial Mapping Co.		JE Fuller	Oblique
14 Oct. 1983	NASA		JE Fuller	1:31,222 - Color IR

Table 1 Cont.

Project Photography Summary

Flight Date	Source	Use	Location	Comments
1980	Unknown		Stantec	Black and White
13 May 1979 9 June 1979	USDA	Agricultural Stabilization and Conservation Service	JE Fuller	1:40,000 - Black and White
24 April 1979	MCDOT		FCDMC	
11-12 June 1978	USBLM (Denver)		JE Fuller	1:24,000 - Color
Mar. 1978	NRCS		FCDMC	
Feb. 1978	NRCS		FCDMC	
1, 5 Dec 1977	Cooper Aerial		JE Fuller	1:20,000 - Black and White
2 Apr. 1976	MCDOT		FCDMC	
June 1971	USGS		JE Fuller	1:78,000 - Black and White
29 Jan. 1970	MCDOT		FCDMC	
21 Jan. 1964	USDA	Agricultural Stabilization and Conservation Service	JE Fuller	1:20,000 Black and White
20 Jan. 1964	MCDOT		FCDMC	
6 Jan. 1958	MCDOT		FCDMC	
3, 5 Jan. 1958	USDA	Agricultural Stabilization and Conservation Service	JE Fuller	1:20,000 Black and White
31 Mar. 1953	Unknown		FCDMC	
12 Feb. 1949 20 Feb. 1949 27 Mar. 1949	USDA		JE Fuller	1:20,000 Black and White
1941	Unknown		Stantec	Incomplete Coverage
1937	Fairchild Survey		JE Fuller	1:24,000 - Black and White

DATA COLLECTION SUMMARY

Engineering

Types of engineering references collected are design/drainage manuals, previous engineering studies and computer program user manuals. Engineering references collected for the El Rio project are subdivided into categories by Hydrology, Hydraulics, Sediment Transport and Geomorphology sub-disciplines groupings.

Hydrology

Data collected specifically for the hydrology task are reviewed to identify peak discharges both synthetic and historic that have been used/developed in previous studies. Peak discharges are utilized in hydraulic, sediment transport, and geomorphic evaluations for existing and proposed conditions. References (Attachment 1) specific to hydrology are noted in the discipline and sub-discipline categories as Engineering and Hydrology respectively.

Hydraulics

References collected for hydraulic analysis include design manuals, flood inundation delineation studies and bridge hydraulic evaluations. References are used to aid in the development of hydraulic models for existing and proposed conditions. Results from models developed for the project will be compared with results/conclusions from previous studies to document variations. The hydraulic model developed for the project will be based on the hydraulic model for the Flood Delineation Study of Salt-Gila Rivers, FCD Contract No's 90-59 & 92-01 prepared by Michael Baker Jr. Inc. References (Attachment 1) specific to hydraulics are noted in the discipline and sub-discipline categories as Engineering and Hydraulics respectively.

Sediment Transport

Sediment transport data collection efforts focused on obtaining bridge scour reports, documents which may contain geotechnical data (Floodplain Use Permits) for the project area and previous sediment transport studies. No specific sediment transport studies for the project area have been obtained, however studies have been prepared for areas up stream of the project area. References (Attachment 1) specific to sediment transport are noted in the discipline and sub-discipline categories as Engineering and Sediment respectively.

Geomorphology

Data collection for the geomorphic analysis focused on changes in channel position and consisted of historic aerial photography, historic survey plat maps produced by the U.S. General Land Office (GLO), digital soil survey maps from the Soil Conservation Service (SCS), geologic maps from the Arizona Geological Survey (AZGS) in both digital and hard copy form, and other miscellaneous reference texts. These photos dating from 1937 through 2001 were employed for the purpose of documenting changes in the Gila River channel over the past 64 years. The GLO maps span 50 years from 1833 through 1933 and provide additional information on historic channel position. Data from the SCS and AZGS sources were used to generate soil and geologic maps for both the channel and piedmont surfaces of the El Rio study reach.

Aerial photos collected by JE Fuller/ Hydrology & Geomorphology are listed in Table 1 under Location: JE Fuller. References (Attachment 1) specific to Geomorphology are noted in the discipline and sub-discipline categories as Engineering and Geomorphology respectively.

Field Survey

As part of the El Rio Watercourse Master Plan, field surveys were conducted to provide topographic detail at specific locations. Survey information was collected to define canal banks and toe elevations, crest elevations of roadways and ground detail along specific hydraulic cross-sections. Data collected to define roadways and canals was utilized in hydraulic models to define potential flow break out from the Gila River. Detail surveys

along hydraulic cross sections was used to verify topographic mapping prepared as part of the Flood Delineation Study of Salt-Gila Rivers, FCD Contract No's 90-59 & 92-01 .

Ground Water Resources

The initial portion of the groundwater investigation involves gathering sufficient data to identify the major flow components of the aquifer system and provide a description of the aquifer parameters. For the El Rio area, the major flow components include:

- outflow, in the form of pumping and groundwater movement out of the area along the western boundary
- inflow from canals, deep percolation from irrigated agricultural fields, and Gila River recharge coupled with groundwater movement into the model across the boundaries; and,
- the changes in storage that result in any dynamic system.

The data necessary to quantify individual components of the groundwater system were assembled from various sources including, but not limited to, government agencies, private utilities and university publications. References (Attachment 1) specific to groundwater are noted in the discipline and sub-discipline categories as Environmental and Groundwater respectively.

The primary data sources included:

- Registry of Grandfathered Rights (ROGR) Data Base: ADWR, Phoenix Active Management Area (AMA) maintains the ROGR Database. All water use within the AMA is reported to this agency each year. Records date from 1982 and can be tracked retroactively to 1975 with some accuracy.
- ADEQ project files: The project files at ADEQ proved an invaluable source of background data for describing the aquifer system in the El Rio area. Reports submitted to ADEQ included detailed lithologic logs of monitor wells, monitor well aquifer test results, historic groundwater elevation information and water quality.
- ADWR: The records from the ADWR Records Section provided well location and construction data, while the Hydrology Section provided files used in compilation of the SRV Model as well as data submitted as part of various Assured Water Supply Studies and General Industrial Use Permits. They also provided data from the Salt River Valley Model on irrigation efficiency in the area, volumes of water pumped and canal leakage.

- Roosevelt and Buckeye Irrigation Districts: Local irrigation districts provided pumping records for all of their wells and effluent diversions from the COP 23rd Avenue Wastewater Treatment Plant (WWTP) as well.

- Cities of Goodyear, Avondale, Tolleson and Buckeye: The local communities have been asked to provide provided historic pumping, groundwater elevation, aquifer test and water quality data.

Environmental

Environmental task for the El Rio Project have been groped into three main categories ecological, water quality and vector and nuisances insects. Data collection efforts for each categories are described in the following sections. A part of the environmental task is to collected data to produce a series of GIS overlays that includes environmental, groundwater, cultural resources and hazardous waste data collection efforts. A descriptions of the GIS overlays and data collection efforts are provide in the GIS Overlays section.

GIS Overlays

A series of nine GIS overlays and maps will be produced to present environmental data that will be used in the watercourse master plan alternative evaluations. The nine natural resource overlays will illustrate critical areas for consideration of habitat enhancement, restoration, avoidance, and mitigation. To aid in the development of these GIS overlays, the environmental data collection effort for El Rio project has focused on four sources for relevant information: published literature, unpublished literature archives, field observation, and agency sources. The data gathered forms the basis of analysis for the formulation of alternatives and for development of the master plan.

The nine environmental data overlays are summarized along with data collection efforts for each.

- *Vegetation communities.* Archival research on vegetation mapping has identified several past studies and mapping efforts in the project area. The most thorough survey was published in 1981 (Clearing of Phreatophytic Vegetation from the Salt and Gila Rivers 91st Avenue to Gillespie Dam, Draft Environmental Impact Statement). See Ecological section for additional information.

  Sources of archival aerial photos have been screened and sourced from Cooper Aerial Surveys Inc. Selection of the most relevant photo from the archives resulted in the development of a near infrared base map to be used for field verification and vegetation mapping.

  Archival research has identified a published source for the near infrared wavelength signature for tamarisk. This published paper supports the

identification and differentiation of tamarisk on near infrared aerial photography.

Field work to update and support published vegetation surveys and habitat mapping studies is ongoing.

- *Protected Species Habitat Areas.* Archival research on critical habitat listings and habitat has focused on the species list for Maricopa County, shown below. The Federal list of protected species is from the most recent updated published at:

  http://www.fws.gov/arizonaes/Documents/CountyLists/Maricopa.pdf (Accessed on Sept. 8, 2005).

  The Federal list of threatened and endangered species in Maricopa County is provided as Table 2.

  Although two species of owl are listed for Maricopa County, a formal listing of critical habitat has just been established for the cactus ferruginous pygmy-owl (Federal Register, Nov. 27, 2002). Based on the revised critical habitat, as published in the recent federal register notice, the El Rio project area is not considered critical habitat for this species.

  http://www.fws.gov/arizonaes/Documents/Redbook/Redbook%20Maps/cactus_ferruginous_pygmy_owl.pdf (Accessed on Sept.8, 2005)

Table 2

Federal List of Threatened and Endangered Species, Maricopa County

LISTED SPECIES

Common Name	Scientific Name	Status
Arizona agave	*Agave arizonica*	Endangered
Arizona cliffrose	*Purchia subintegra*	Endangered
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	Endangered
California Brown pelican	*Pelecanus occidentalis californicus*	Endangered
Desert pupfish	*Cyprinodon macularius*	Endangered
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	Endangered

Table 2 Cont.

Federal List of Threatened and Endangered Species, Maricopa County

Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	Endangered
Mexican Spotted Owl	*Strix occidentalis lucida*	Threatened
Razorback sucker	*Xyrauchen texanus*	Endangered
Sonoran pronghorn	*Antilocapra Americana sonoriensis*	Endangered
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered
Yuma clapper rail	*Rallus longirostris yumanensis*	Endangered

PROPOSED SPECIES

Common Name	Scientific Name	Status
Gila chub	*Gila intermedia*	Proposed Endangered

CANDIDATE SPECIES

Common Name	Scientific Name	Status
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate

- *Hydrologically Enhanced Areas:* The groundwater and geomorphologic tasks will provide the basis for the GIS overlay showing hydrologically enhanced areas.

- *Potential Habitat Restoration or Enhancement Areas*: Archival research has been conducted to identify lands that are already in programs to promote wildlife habitat improvement through conservation easements or incentive programs.

  The El Rio team reviewed available data including US Fish & Wildlife Service, Arizona Game & Fish Department, BLM, Arizona State Cartographers Office, National Biological Information Infrastructure, and records of easements from the Maricopa County Recorders Office.

Interviews included discussion with Mr. Jim Neveu of the NRCS. To date, no data has been discovered that indicates the presence of wildlife protection or conservation easements within the study area.

The El Rio team reviewed funding sources found on the internet to determine if grants had been awarded for programs within or adjacent to the study area. No grants were found for the following:

The *Partners for Fish and Wildlife Program*, through partnerships with conservation groups and federal/state/tribal/local government agencies, provides technical and financial assistance to private landowners interested in voluntarily restoring or otherwise improving native habitats for fish and wildlife on their lands. This program focuses on restoring former and degraded wetlands, native grasslands, stream and riparian areas, and other habitats to conditions as natural as feasible.

The *Wildlife Conservation and Appreciation Program* provides grants to fund projects that bring together the U.S. Fish and Wildlife Service, state agencies, and private organizations and individuals. Projects include identification of significant problems that can adversely affect fish and wildlife and their habitats, actions to conserve species and their habitats, actions that will provide opportunities for the public to use and enjoy fish and wildlife through nonconsumptive activities, monitoring of species, and identification of significant habitats.

Conservation Reserve Program is a voluntary program that offers long-term rental payments and cost-share assistance to establish long-term, resource-conserving cover on environmentally sensitive cropland or, in some cases, marginal pastureland. The protective cover reduces soil erosion, improves water quality, and enhances or establishes wildlife habitat. Increased rental payments are available on certain land areas (e.g., land within a wellhead protection area may receive an additional 10 percent payment).

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat on private lands. It provides both technical assistance and cost sharing to help establish and improve fish and wildlife habitat. Participants work with USDA's Natural Resources Conservation Service to prepare a wildlife habitat development plan in consultation with a local conservation district.

- *Important Wildlife Habitat Areas or Components* (ie. travel corridors). Interviews of AZ Game and Fish, US Fish and Wildlife, and Regional Park personnel have been completed to identify wildlife issues and concerns in the El Rio project area. Field work to identify reproduction, roosting, and movement areas has been initiated. Work to date has identified a Heron Rookery at the Buckeye Irrigation District Water

impoundment (Mecks Lake). Flyway corridors from this Heron rookery have been observed along the river corridor to feeding areas to the South and West. Seasonal travel routes for large numbers of Great Egrets have been observed from the Meck Lake area to concentrated feeding areas on canal systems south and west of the project area border at the State 85 bridge. Other flyways, travel corridors, and nesting areas will be identified as field work progresses. See Ecological section for additional information.

- *Identified Cultural Resource Sites* (as identified by the DISTRICT). Work on data collection and integration is pending completion of county efforts and survey work.

- *Significant Hazardous Material Sites* (as identified by DISTRICT). Work on data collection and integration is pending completion of county efforts and survey work.

- *Significant Solid Waste Sites*. Work on data collection and integration is pending completion of county efforts and survey work. The inventory and data collection effort for solid waste is being produced by the MCFCD. Field observations and survey locations of solid waste accumulations are being collected as field work encounters them. One inactive "official" landfill has been identified during data collection. Evidence of recent debris and trash dumping is observed throughout the study area. Highest solid waste densities have been observed along the utility corridor downstream of the Estrella Bridge on the north side.

- *Other Environmental Constraints Or Opportunities As Noted.* Archival research has focused on tamarisk ecology, reproduction, control, and natural history. The types of active management tools that have been identified by researchers for Tamarisk control include fire, chemical, biological, physical, grazing, water level management, seed bed manipulation, and competition from other species. Use of Tamarisk by protected and important wildlife species is also identified as a critical issue.

The nine overlay maps identified above will be utilized to integrate consideration of environmental issues into the planning and alternative formulation process.

Ecological

Ecological data collection efforts included an in-depth collection of literature regarding growth development and life cycles of native and introduced riparian plants/habitats of the southwestern United States. The research mainly consists of published research (predominately derived from Arizona State University, the University of Arizona, the Arizona Department of Environmental Quality, the United States Environmental Protection Agency, and the United States Fish and Wildlife Services), focusing on

ecological characterization, value of riparian plant communities and restoration. References (Attachment 1) specific to ecological data are noted in the discipline and sub-discipline categories as Environmental and Biological Resource respectively.

Highlights include:

- Flood flows and dynamics relationship on establishment of riparian species.
- Effects of salinity on establishment of riparian species
- Seeds and seedling development of riparian species
- Response of riparian species to groundwater table declines
- Evapotranspiration rates for riparian species
- Ecological characterization
- The Spread of invasive plant species
- Management of invasive species

In addition to the highlights listed above a synopses of selected articles listed in Attachment 1 are provided as Attachment 2 (Environmental Planning Data Collection Synopsis, by EcoPlan Associates, Inc.).

Additional literature was also collected on the hydraulic roughness of riparian species for use in modeling river dynamics. Further, information was collected regarding the use of drag coefficients and resistance factors used for modeling flow in vegetated channels. Lastly, information on saltcedar control/management techniques, including life cycle interruption, chemical, physical, and mechanical methods was also obtained.

Selected agencies were interviewed to obtain there concerns, issues and guidance concerning the ecological aspects of the El Rio Water course Master Plan. The agencies interviewed are; the U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Maricopa County Parks and Recreation Department, and the United States Department of Agriculture. Interview summaries and information provided by the interviewee are provided as Attachment 3.

Water Quality

The data collection effort for water quality consisted of gathering available data on the quality and quantity of stream flow and surface water inputs to the river system from the confluence of the Gila and Agua Fria at the upstream reach downstream to the SR 85 crossing. The objective is to develop data resources to characterize the quality and quantity of surface water in the river, its existing sources, and potential changes anticipated in the future.

Sources of surface water to/in the river include:

- municipal effluent treated to varying degrees from upstream and nearby wastewater treatment plants,
- untreated stormwater and agricultural run-off,
- direct precipitation, and
- releases from upstream reservoirs.

Data necessary to characterize water quality were assembled from a variety of sources including but not limited to: government agencies, private utilities, and published literature.

Primary data sources included:

- Baseline ecological characterization of the Salt-Gila River, prepared in 1997, which contained baseline water quality, vegetation, plankton and aquatic invertebrates, fish, herpetofauna, birds, mammals, and environmental contaminants data.
- U.S. Geological Survey: Streamflow data was collected from an in-stream gage station located on the Gila River at the Estrella Parkway Bridge. Data includes, daily, weekly, and annual flow from 1975 through 2000.
- U.S. Geological Survey: Water quality data from surface water samples collected along the Gila River Basin in New Mexico and Arizona.
- Stormwater sampling data: collected from 29 locations in the Phoenix metropolitan area.
- U.S. Fish and Wildlife Service: Research findings on environmental contaminants in fish and wildlife of the Lower Gila River, Arizona. The study conducted in 1994 and 1995 sampled fish from Dysart drain, Roosevelt Canal, Buckeye Canal, and Gillespie Dam.
- ADEQ: A risk assessment of recreational use of lakes in the Lower/Middle Gila River, which assess the level of chemical contamination present in the environment and the associated health risk to users.
- Maricopa Association of Governments: The MAG 208 Water Quality Management Plan, updated October of 2002, contains detailed description of wastewater treatment plants, methods of treatment, current capacities, and future expansion schedules through the year 2020. The report includes the City of Phoenix which operates the upstream 91st Avenue

WWTP, the City of Avondale which operates the Avondale WWTP and plans an additional Northside WRP in the future, the City of Goodyear which operates the Corgette and Goodyear facilities, and the Town of Buckeye which operates the Buckeye WWTP and is in the planning stages for the Sundance, Whitestone, and Blue Horizon WRP.

- Arizona Meteorological Network (in cooperation with the Roosevelt Irrigation District): Provides precipitation, evapotranspiration, temperature, and humidity data collected from a station located in Buckeye, Arizona. Daily, weekly, monthly, and annual data is available from 1998 through present.

In addition stormwater management plans were obtained to assess impacts of local construction activities may have upon the quality and quantity of stormwater runoff as future development occurs. Stormwater management plans were obtained from the State of Arizona, Maricopa County, and local jurisdictions.

Vector and Nuisance Insects

A variety of documents have been collected for vector and nuisance insect identification, life histories, ecology, and management. Similarly, a number of resources have been identified for surface water and vegetation management associated with aquatic insect control. Regional mosquito and midge fly data were readily available from nearby areas and included project reports, health department arbovirus monitoring updates, and personal communications from Arizona Department of Health Services and Maricopa County Vector Control. However, mosquito and nuisance insect data for the project area are limited. Therefore, the project team collected site-specific mosquito data during the fall of 2002 to supplement the database.

Primary data and guidance documents are summarized below. Supplemental references are provide in Attachment 1 References specific to vectors are noted in the discipline and sub-discipline categories as Environmental and Vector respectively.

Project Reports:

- Phoenix Tres Rios mosquito monitoring, 1996-present.
- Holly Acres mosquito monitoring, 1999-present.
- Phoenix Rio Salado mosquito monitoring, 1999-present.
- El Rio mosquito monitoring, 2002.
- Tres Rios Demonstration Constructed Wetland Project, 1996/1997 Operation & Water Quality Report
- 91st Avenue Vector and Midge Control Program Report, 1996

Government Agencies:

- Maricopa County Vector Control.
- Arizona Department of Health Services.

General References:

- Identification and Geographical Distribution of the Mosquitoes of North America North of Mexico.
- The Mosquitoes of Nevada, 1966.
- Mosquitoes of Arizona, 1973.
- An Identification Guide to the Mosquitoes of Utah, 1961.
- Mosquitoes.
- Arizona Climate Summary
- The *Chironomidae*. Biology and Ecology of Non-biting Midges.
- The Mosquitoes of the Southern United States.
- The First lake Maintenance Handbook
- Mosquitoes of California
- Indiana Commercial Pesticide Applicator Training Manual
- The Lake and Reservoir Restoration Guidance Manual
- Restoration and Management of Lakes and Reservoirs
- Constructed Wetland Technology and Mosquito Populations in Arizona
- Freshwater Vegetation Management
- University of Florida Aquatic Plant Management Manual
- Constructed Wetlands Treatment of Municipal Wastewaters

Vector and Nuisance Insect Management:

- Epidemiology and Control of Mosquito-Borne Arboviruses in California, 1943-1987.
- Florida Mosquito Control Handbook
- A Mosquito Control Strategy for the Tres Rios Demonstration Constructed Wetlands Final Report, July 1999.
- Habitat Management for the Control of Wastewater *Culex* Mosquitoes
- Wetland Development and Management Guidelines for the Control of Mosquitoes
- Guidelines for Controlling Mosquitoes in Water Retention/Detention Areas
- Lake Fly Allergy: Incidence of Chironomid Sensitivity in an Atopic Population
- Initial Vector Surveillance Cave Buttes Recreation Area

Hazardous Material

Various environmental records from federal, state, county, and local agencies were reviewed by the District to identify whether hazardous material sites or potential hazardous material sites are located within the El Rio WCMP project area or at offsite locations within the specified minimum search distance. Details of the hazardous material evaluation are discussed in the Environmental Resources Report.

Cultural/Historical Resources

The Flood Control District of Maricopa County retained James B Rodgers of Scientific Archaeological Services, to conduct a cultural assessment of the El Rio project area. The comprehensive assessment presented information about, and locations for, all known significant cultural resources sites in the El Rio locale. The maps contained within the assessment were utilized to produce GIS layers. The GIS layers are then used to define potential conflicts with proposed flood control management alternatives. If a flood control project will potentially impact any cultural resources, then measures would be taken to record and mitigate adverse effects to the cultural resources in the area. Details of Cultural/Historical Resources are discussed in the Environmental Resources Report.

Land Uses

Planning documents developed by communities have a land use element that provides a framework for defining future development patterns. The Land Use element helps guide future growth, revitalization and preservation efforts in the community. An understanding of future growth or anticipated land use is key to the development of a watercourse master plan. References (Attachment 1) specific to land use planning are noted in the discipline category as Planning.

Data Source:

Land Use within the El Rio Watercourse Master Plan study area is governed by the jurisdictions of the City of Buckeye, the City of Goodyear and the City of Avondale and Maricopa County. Data collection was accomplished through the representatives of the stakeholder cities and Maricopa County. The City of Goodyear contact is Kevin Kugler. The City of Buckeye contact is Joseph Blanton. The City of Avondale contact is Dan Davis and Maricopa County contact is Matthew Holm.

Data:

Table 3 "Land Use Data Collection Summary" lists the various categories of data collected and document findings.

Existing Land Use/Land Ownership Data:

Data collection for land ownership and existing land use was gathered from Maricopa County Assessors records (www.maricopa.gov). A land ownership document depicting land ownership, parcel boundaries, project boundaries, floodplain limits and existing

land-use was developed for the project as a separate document. The document is entitled El Rio Parcel Map.

Table 3

Land Use Data Collection Summary

ITEM	AVONDALE	BUCKEYE	GOODYEAR	MARICOPA COUNTY	OTHER	DATA SOURCE
PARCEL OWNERSHIP / EXISTING LAND USE						
Maricopa County Assessors Ownership and Land Use Code D	MC	MC	MC	MC		MC
CITY / COUNTY FUTURE LAND USE MAPS						
General Plan (HC)	HC	HC	HC	HC		A, B, G, MC
General Plan – land use mapping	DF	DF	DF	DF		A, B, G, MC
Boundary (include City most recent annexed areas)	DF	DF	DF	DF		A, B, G, MC
Zoning			HC	DF		G, MC
Water Sewer Treatment Plants		HC				B
AIRPORT PLANS						
General Plan / Luke AFB Contour Map -					HC / DF	STANTEC & WEB Site
Goodyear Airport Contour Map -			DF			WEB Site
PROPOSED DEVELOPMENT						
Developer Private Concept Plans / Preliminary Plans	HC	HC	HC	Do Not Have		A, B, G, MC
Proposed City Projects		HC	HC	Do Not Have		
STUDIES HARD COPIES (digital if available)						
Avondale and Goodyear Engineering Standards	HC		HC			A, G
City of Goodyear Parks, Trails and Open Space Master Plan With Executive Study			HC			G
City of Avondale Parks and Recreation - Open Space Master Plan	HC					A
City of Avondale Tres Rios Greenway Specific Plan	HC					A
City of Avondale "73 El Mirage Property"	HC					A
Maricopa County Trail Plan				HC / DF		MC

Table 3 Cont.

Land Use Data Collection Summary

ITEM	AVONDALE	BUCKEYE	GOODYEAR	MARICOPA COUNTY	OTHER	DATA SOURCE
Agua Fria Watercourse Master Plan by Kimley Horn November 2001 for MCFCD				HC		MC
West Valley Recreation Corridor, July 1999, by Carter Burgess for MCFCD				HC		A
Southwest Valley Transportation Study Maricopa County, October 1996, by BRW				HC		MC
Little Rainbow Valley Land Use Maricopa County, Jan 1992				HC		MC
Desert Spaces Environ. Sensitive Development Area, June 2000, for Maricopa County by SWCA				HC		MC
Estrella Mountain Regional Park Long Range Master Plan, 1987, by BRW for Maricopa Parks and Recreation				HC		MC
SRP Substation, Southwest Valley, between 119th Ave & 121st Ave and Lower Buckeye and Broadway Road, 31 July 2002, by TKC Engineers	HC					A
Town of Buckeye Wastewater Master Plan, February/March 2000, by David Evans and Associates		HC				B
Town of Buckeye Final Traffic Circulation Parking Study, 27 September 2001, by Entranco		HC				B
Town of Buckeye Development Code, Revised 19 August 1996, by Town of Buckeye		HC				B
Town of Buckeye Final report Buckeye Town Lake Engineering Feasibility Study, 1 November 2001, by URS/BRW						B
Luke AFB General Plan (hard copy), April 2002, by Stantec					HC	STANTEC

HC - Hard Copy; DF - Digital File; A - City of Avondale; B - Town of Buckeye; G - City of Goodyear; MC - Maricopa County

Existing Airports:

Two airports are located in the vicinity of the project, Luke Air Force Base and the Phoenix-Goodyear Airport. Portions of the Phoenix-Goodyear airport are located within the project area. Flight pattern and air craft noise contour maps for both airports and wildlife attractant separations zone for the Goodyear Airport have been obtained.

Future Land Use Data:

Data Collection for Future Land Use was gathered from the General Plan Maps of the stakeholder cities of Goodyear, Buckeye and Avondale and from Maricopa County. For cities, future land use is based on the City General Plan Land Use maps. For Maricopa County, future land use is based the Maricopa County Land Use and Zoning maps. The individual jurisdiction Land Use map for each jurisdiction is provided as Figures 1, 2, 3 and 4 for the City of Avondale, The Town if Buckeye, the City of Goodyear and Maricopa County respectively . "Composite Land Use Designations Within El Rio Study Area" (Figure 5) was created by Stantec from the individual jurisdiction land use maps. The composite future Land Use Map depicts the El Rio Study Area land use designation for development at 0-1 dwelling units per acre (Du/Ac), 1 to 2 Du/Ac, 2 + Du/Ac, 4+ Du/Ac, Commercial, Industrial, Mixed Use, Open Space, Public/Quasi Public and Water.

Future Conceptual Development Projects Under Consideration:

The stakeholder project representative from each of the Cities and the contact for Maricopa County provided input as to the proposed concept and preliminary plans in progress within each of their individual jurisdictions. When available a copy of the current, future, private/public, conceptual, development project schematics were gathered from the stakeholder cities and Maricopa County. Table 4, "Summary Conceptual Development Projects" lists the development plans in progress across the El Rio Project study area. To date, proposed development plans include the Lakin Property at 115th Avenue in the City of Avondale (1,326-acre); the City of Buckeye projects such as the Olympic Properties commercial project on Watson and Hwy 85 (18-acres, the potential project at MC 85 and Baseline/Rainbow Road (80-acres), the Norte Vista in Buckeye (63-acres) and the Buckeye Town Lake project (160-acres), and the City of Goodyear concept development projects include the Estrella Commerce Park and Riverside Park (298-acres). In Maricopa County the projects in concept plan or preliminary planning stages were the Arizona Department of Correction Facility on 192nd Avenue, Kings Ranch, Southwest Desert Estates (40-acres) and Rainbow Valley Ranch Estates (49-acres)

Table 4

Summary of Conceptual Development Projects

Jurisdiction	Name of Proposed Project	Project Location	Owner or Developer	Acres	City Number	Proposed Density	Concept Plan
Avondale	Lakin Ranch	Broadway Road West of 115th Ave to 135th Ave	Pulte Homes-John Dannon 480-391-6143	1,200		2.78 DU/Ac	Planning
Buckeye	Olympic Properties	MC 85 & Watson	Bob Waggoner (602) 494-0133	18 to 1,000		18 Ac Commercial & Res. @ 4 DU/Ac	Unknown
Buckeye	Ed Richenburg	MC 85 & Rainbow Road/Baseline	Ed Richenburg (??)	80			Unknown
Buckeye	Norte Vista	SWC MC 85 (Baseline) & Rainbow Valley Road Between Jackrabbit Trail and Rainbow Valley Road Alignment Portion of Northeast quarter of section 5 township 1 south range 2 west of Gila Salt River Base and Meridian Maricopa County	Unknown	63.29	Hunn # 99013	1.6 DU/Ac (39 lots)	Unknown
Buckeye	Buckeye Town Lake	SEC of Miller & Hazen Road	Town of Buckeye Jeanine Guy - Parks Recreation 623-386-2778	160	789907	Lake	Planning
Buckeye	Wastewater Treatment Plant Expansion	South of Beloat, North of the proposed Buckeye Town Lake at the site of the existing wastewater treatment plant.	Town of Buckeye Ian Dowdy 623-386-8299			Treatment Plant	Under Construction

Table 4 Cont.

Summary of Conceptual Development Projects

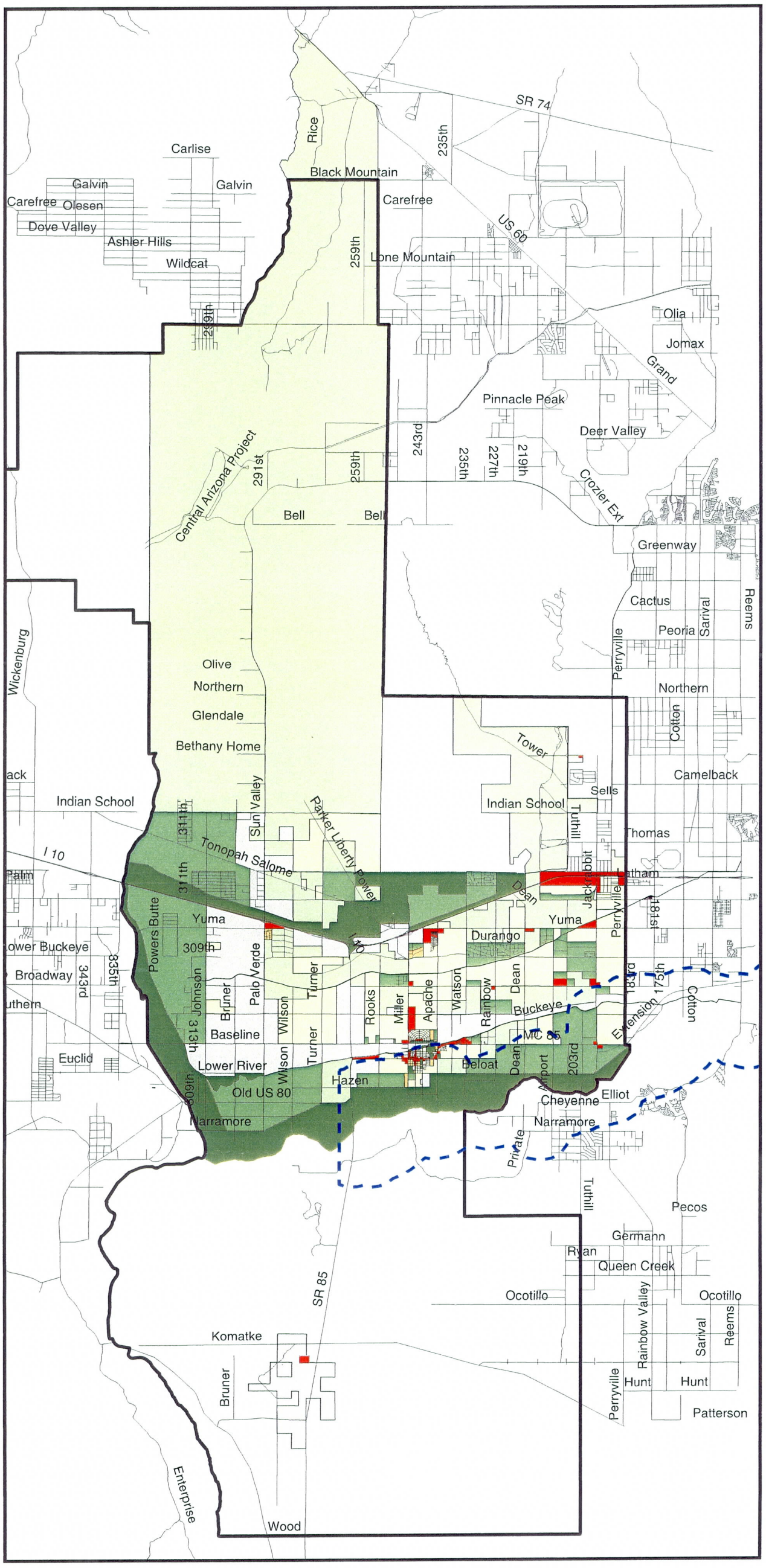
Jurisdiction	Name of Proposed Project	Project Location	Owner or Developer	Acres	City Number	Proposed Density	Concept Plan
Maricopa County	Empty Acres	SWC of Beloat and Miller				Equestrian Facility	Under Construction
Goodyear	Riverside Park	South of MC 85 at Sarival Avenue	Cornoyer-Hedrick	298.5	CH # 99239 W	Commercial Park and Residential @ 3.47 Du /G Ac	
Goodyear	Estrella Commerce Park	Between the Goodyear Airport and Gila River & Between Estrella Parkway and Bullard Avenue	SunMP- Todd Tupper			Master Plan & Commercial Park	
Goodyear	Estrella Mountain Ranch	MC 85, Perryville, Estrella Parkway	Newland Communities Wayne Hancock 602-468-0800	6,000 +		Master Planned Community	
Goodyear	Kings Ranch and Lakin Cattle	Between MC 85 & Beloat / Jackrabbit and Cotton Lane	Sonterra Partners Ed King 602.617.3641	1,500 +		Master Planned Community	Permitting

NEC=Northeast Corner; NWC=Northwest Corner; SEC=Southeast Corner

El Rio Watercourse Master Plan

Figure 1

Town of Buckeye General Plan



LANDUSE

- Planned Residential
- Planned Community
- General Commerce
- Mixed Residential
- Commercial Center
- Rural Residential
- Planned Community
- General Commerce
- Special Use
- Municipal Planning Boundary
- Streets
- El Rio Project Boundary

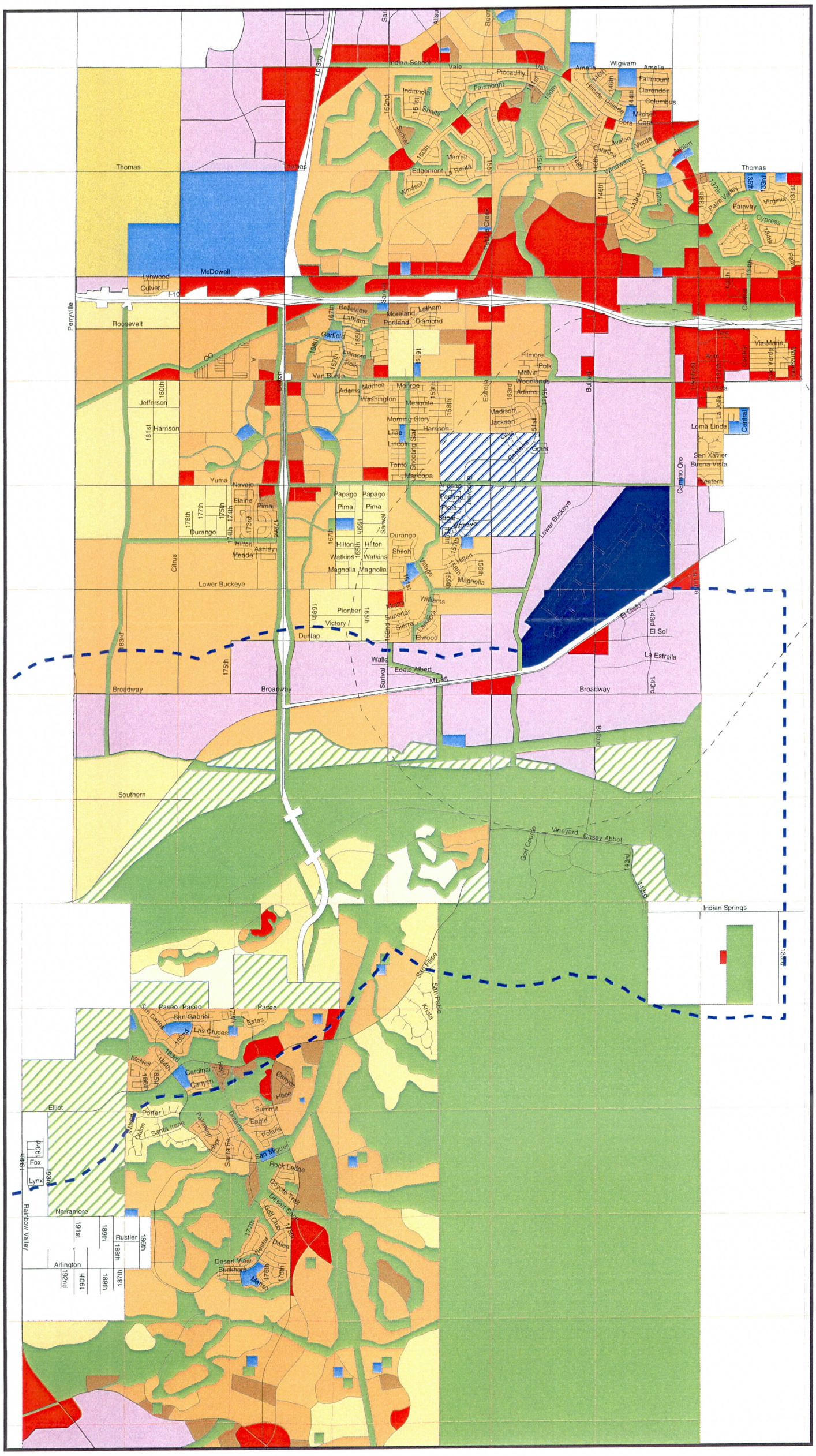
0 1 2 4 6

Miles

Information Updated 12/2002

El Rio Watercourse Master Plan

Figure 2
City of Goodyear General Plan

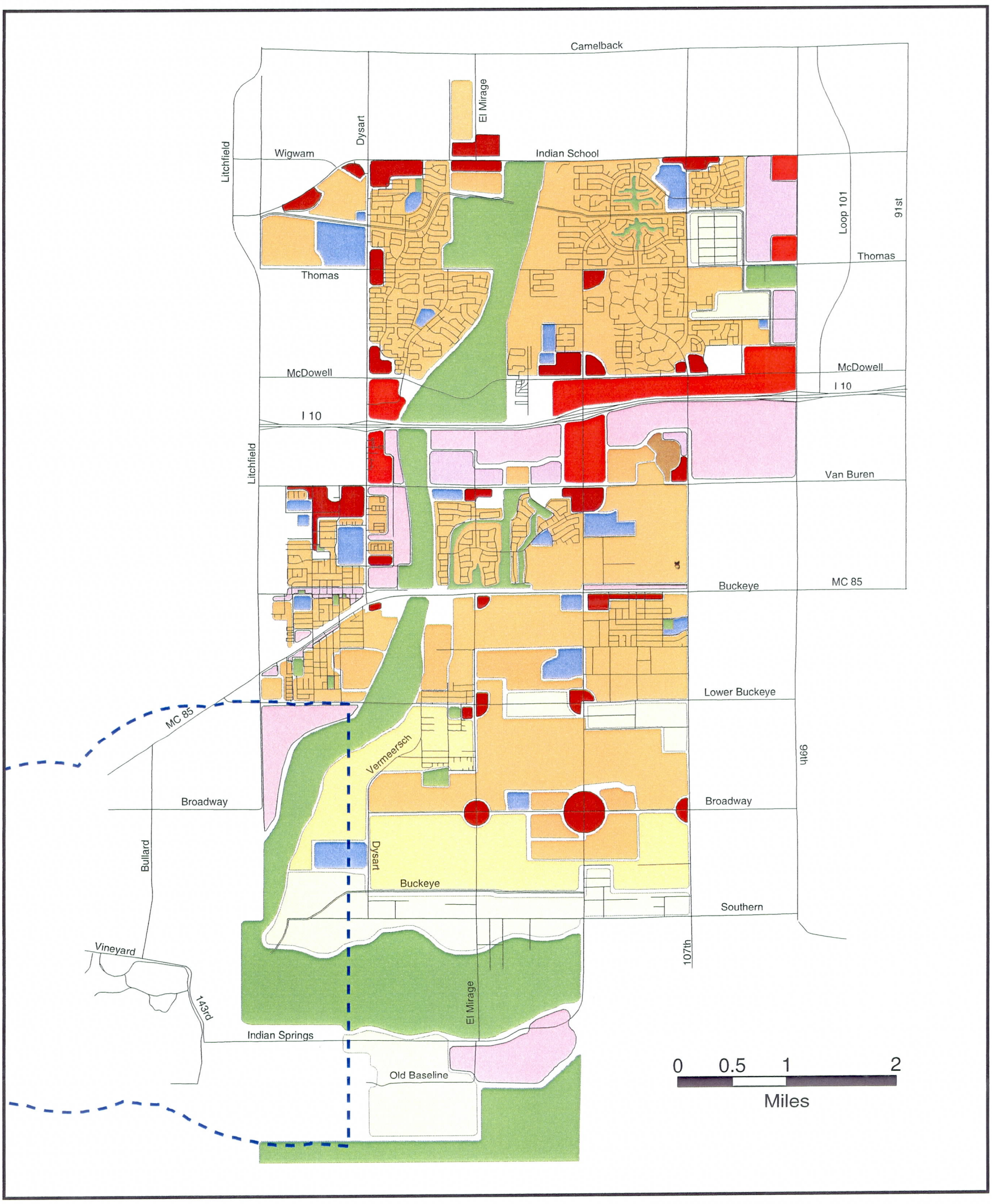


Information Updated 8/2005

El Rio Watercourse Master Plan

Figure 3

City of Avondale General Plan



LANDUSE

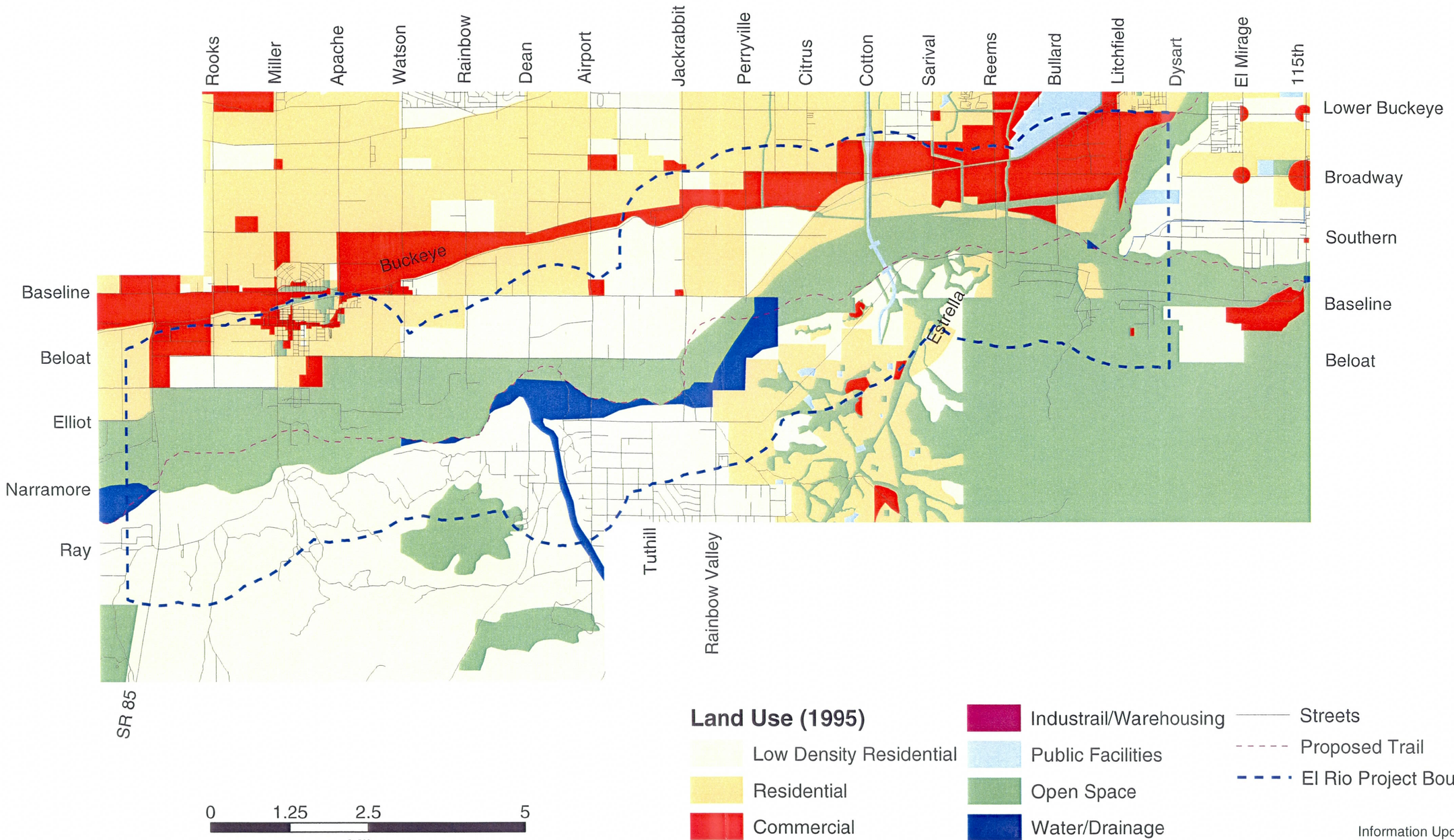
- Freeway Commercial
- Commercial
- Mixed Use
- Employment
- High Density Residential
- Medium High Density Residential
- Medium Density Residential
- Low Density Residential
- Rural Low Density Residential
- Open Space
- Public Facilities
- Streets
- El Rio Project Boundary

Information Updated 7/2003

El Rio Watercourse Master Plan

Figure 4

County Land Use



ATTACHMENT 1:

El Rio Project Reference List

El Rio References

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
2	City of Avondale	8/1/01	Draft General Plan Update		Planning		Stantec
3	City of Goodyear	May, 1998	Goodyear General Plan	By Cornoyer-Hedrick	Planning		Stantec
4	City of Phoenix, Water Services Department	May, 1995	91st Avenue Wastewater Treatment Plant Effluent Discharge Route Study	By Greiner	Environmental		Stantec
5	City of Phoenix, Water Services Department	December, 1995	Flood Mitigation Design at the 91st Avenue Wastewater Treatment Plant, Salt River Hydraulic and Sediment Transport Analysis	By Simons, Li & Associates,	Engineering	Hydraulics / Sediment	Stantec
6	Flood Control District of Maricopa County	July, 1999	West Valley Recreation Corridor, Design Concept Report, Executive Summary	By Carter Burgess	Planning		Stantec
7	Flood Control District of Maricopa County	June, 2001	Draft, Existing condition Hydrology, Loop 303 Corridor/White Tanks Area Drainage Master Plan Update	By URS	Engineering	Hydrology	Stantec
8	Flood Control District of Maricopa County	Undated	A Chronology of Significant Floodplain Management Events		All Disciplines		Stantec
9	Flood Control District of Maricopa County	31-Jan-94	Finial Report for the Salt-River Watercourse Master plan Scoping Project (Task 8.0)	By Woodward-Clyde	All Disciplines		Stantec
10	Flood Control District of Maricopa County	Revised October, 2001	El Rio Parcel Map Index Sheet		All Disciplines		Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
11	Flood Control District of Maricopa County	November, 2001	Agua Fria Watercourse Master Plan, Executive Summary	By Kimley-Horn and Associates,	All Disciplines		Stantec
12	Flood Control District of Maricopa County	10/29/99	Contract FCD 99-24 Consultant Services for the Agua Fria Watercourse Master Plan Study		All Disciplines		Stantec
13	Flood Control District of Maricopa County	Undated	El Rio, Summary Report		All Disciplines		Stantec
14	James B. Rodgers and Nancy Dallett	22-Nov-01	A Selected Sample of Prehistoric and Historic Sites of the Western Salt River Valley, Arizona		Environmental	Archaeology	Stantec
15	Maricopa Association of Governments	Oct. 28, 1994	Desert Spaces		Planning		Stantec
16	Maricopa Association of Governments	June, 2000	Desert Spaces, Environmentally Sensitive Development Areas (ESDA), policies & Design Guidelines		Planning		Stantec
17	Maricopa County	10/20/97	Comprehensive Plan, Maricopa County 2020, Eye To The Future		Planning		Stantec
18	Maricopa County	6-Jan-92	Maricopa County land Use Plan , Little Rainbow Valley Planning Area		Planning		Stantec
19	Maricopa County Department of Transportation	28-Sep-98	Revised Final Report, Bridge Scour Investigation and Design of Corrective Measures, Structures Number 8485 Tuthill	By Baker	Engineering	Hydraulics / Sediment	Stantec
20	Maricopa County Department of Transportation	Undated	Southwest Valley Transportation Study	By BRW	Planning		Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
21	Maricopa county Parks and Recreation Department	Undated	Estrella Mountain Regional Park, Long-Rang Master Plan	By BRW	Planning		Stantec
22	RH & Associates	31-Aug-99	Partnering Session for El Rio Visionary Meeting		Public Involvement		Stantec
23	Town of Buckeye	Undated	Power Point Presentation-Buckeye Lake Feasibility Study	By URS	Public Involvement		Stantec
24	Town of Buckeye	5-Sep-89	General Development Plan, 1989-2000		Planning		Stantec
25	Town of Buckeye	April, 2001	Town of Buckeye, Growing Smarter Plus Elements, General Development Plan Update (Draft)		Planning		Stantec
26	Tres Rios River Management Plan Steering Committee	September, 1998	Steering Committee Summary Report and Consensus Plan		All Disciplines		Stantec
27	U.S. Army Corps of Engineers, Los Angeles District	11-Jan-00	Low Flow Channel Design Analysis for Rio Salado (Salt River), Arizona, Technical Appendices II	By West Consultants	Engineering	Hydraulics	District / Stantec
28	U.S. Army Corps of Engineers, Los Angeles District	July, 1995	Hydrologic Evaluation of Impacts of New Waddel Dam on Downstream Peak Discharges in the Agua Fria River, Agua		Engineering	Hydrology	District / Stantec
29	U.S. Army Corps of Engineers, Los Angeles District	April, 1981	Flood Damage Survey, Phoenix, Arizona, February 1980		Engineering	Hydraulics	District / Stantec
30	U.S. Army Corps of Engineers, Los Angeles District	March, 1968	Flood Plain Information, Agua Fria River, Maricopa County Arizona		Engineering	Hydraulics	District / Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
31	U.S. Army Corps of Engineers, Los Angeles District	9-Nov-99	Portions of Scope of Work, Special Area Management Plan		All Disciplines		District / Stantec
32	U.S. Army Corps of Engineers, Los Angeles District	February, 1999	Scope of Work, Special Area Management Plan, San Diego Creek and San Juan Creek Watersheds, Orange County, California		All Disciplines		District / Stantec
33	U.S. Army Corps of Engineers, Los Angeles District	June, 1992	Central Maricopa county Drainage Area Arizona, Reconnaissance Study		Engineering	Hydrology	District / Stantec
34	U.S. Army Corps of Engineers, Los Angeles District	March, 1996	Section 7 Study for Modified Roosevelt Dam, Arizona (Theodore Roosevelt Dam), Hydrologic Evaluation of Water Control		Engineering	Hydrology	District / Stantec
35	VEA Consulting Engineers	4-Dec-85	Draft, Salt River 51st Avenue to 35th Avenue Hydraulic and Sediment Transport Study	VEA Consulting Engineers	Engineering	Hydraulics / Sedimentation	District / Stantec
36	U.S. Army Corps of Engineers, Engineering and Design	15-Nov-89	Environmental Engineering for Local Flood Control Channels		Engineering	Hydraulics / Sedimentation	Stantec
37	U.S. Army Corps of Engineers, Engineering and Design	31-Oct-94	Channel Stability Assessment for Flood Control Projects		Engineering	Hydraulics / Sedimentation	http://crrel43.crrel.usace.army.mil:4040/webpub/plsql/usace_search.simple
38	Arizona Department of Water Resources, Engineering Division, Flood	July, 1996	Requirements for Floodplain and Floodway Delineation in Riverine Environments (SS 2-96).		Engineering	Hydraulics	Stantec
39	Arizona Department of Water Resources, Engineering Division, Flood	September, 1996	1996, State Standard for Watercourse System Sediment Balance (SS 5-96).		Engineering	Sediment	Stantec
40	Arizona Department of Water Resources, Engineering Division, Flood	Nov-94	State Standard for Supercritical Flow (SS 3-94).		Engineering	Hydraulics	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
41	Chow	1959	Open Channel Hydraulics	Chow	Engineering	Hydraulics	Stantec
42	Federal Emergency Management Agency	1995	Flood Insurance Study, Guidelines and Specifications for Study Contractors		Engineering	Hydraulics	Stantec
43	Flood Control District of Maricopa County	August 4, 1986,	Flood Regulations for Maricopa County.		Engineering	Hydrology / Hydraulics	Stantec
44	Flood Control District of Maricopa County	February 25, 1987	Uniform Drainage Policies and Standards for Maricopa County.		Engineering	Hydrology / Hydraulics	Stantec
45	Flood Control District of Maricopa County	September 26, 1988	Drainage Regulations for Maricopa County.		Engineering	Hydrology / Hydraulics	Stantec
46	Flood Control District of Maricopa County	1995	Drainage Design Manual for Maricopa County, Volume 1.		Engineering	Hydrology	Stantec
47	Flood Control District of Maricopa County	1996	Drainage Design Manual for Maricopa County, Volume 2.		Engineering	Hydraulics	Stantec
48	U.S. Department of the Interior, U.S. Geological Survey	1991	Estimating Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona.	By Thomsen, B.E., Hjalmarson,	Engineering	Hydraulics	Stantec
49	U.S. Army, Corps of Engineers	1990	HEC-1 Flood Hydrograph Package Users Manual.		Engineering	Hydrology	Stantec
50	U.S. Army, Corps of Engineers	2001	HEC-RAS Hydraulic Reference Manual.		Engineering	Hydraulics	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
51	U.S. Department of Agriculture, Soil Conservation Service	1977	Soil Survey of Maricopa County, Arizona, Central Part.		Engineering	Environmental	Stantec
52	U.S. Department of Commerce, National Oceanic and Atmospheric	1973	Precipitation-Frequency Atlas of the Western United States, Volume VIII-Arizona.		Engineering	Hydrology	Stantec
53	U.S. Department of Commerce, National Weather Service	1984	Depth-Area Ratios in the Semi-Arid Southwest United States: NOAA Technical Memorandum NWS Hydro-40.		Engineering	Hydrology	Stantec
54	U.S. Army, Corps of Engineers, Ecosystem Management and	February 2000	Glossary of Stream Restoration Terms		All Disciplines	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
55	U.S. Army, Corps of Engineers, Ecosystem Management and	February 2000	Coir Geotextile Roll and Wetland Plants for Stream bank Erosion Control		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
56	U.S. Army, Corps of Engineers, Ecosystem Management and	February 2000	Computing Scour		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
57	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2000	Determining Drag Coefficients and Area for Vegetation		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
58	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2000	Reconnection of Floodplains with Incised Channels		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
59	U.S. Army, Corps of Engineers, Ecosystem Management and	February 2000	Irrigation Systems for Establishing Riparian Vegetation		Planning	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
60	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2000	Stream bank Habitat Enhancement with Large Woody Debris		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
61	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2000	Rootwad Composites for Stream bank Erosion Control and Fish Habitat Enhancement		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
62	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2000	Gabions for Stream Bank Erosion Control		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
63	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2001	Brush Mattresses for Stream bank Erosion Control		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
64	U.S. Army, Corps of Engineers, Ecosystem Management and	April 2000	Design Recommendations for Riparian Corridors and Vegetated Buffer Strips		All Disciplines	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
65	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2001	Stability Thresholds for Stream Restoration Materials		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
66	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2001	Impacts of Stabilization Measures		Engineering	Hydraulics	http://www.wes.army.mil/el/emrrp/tnotes.html
67	C. Jack Deloach, Raymond I. Carruthers, Jeffrey E. Lovich, Tom L. Dudley and	Undated	Ecological Interactions in the Biological Control of Saltcedar (Tamarix spp.) in the United States: Toward a New Understanding	C.Jack Deloach and others	Environmental	Biological Resources / Tamarisk	Stantec
68	Dave Rosgen	1996	Applied River Morphology (Second Edition)	Dave Rosgen	Engineering	Hydraulics / Sediment	Stantec
69	U.S. Army, Corps of Engineers, Ecosystem Management and	May 2001	Technologies for urban stream restoration and watershed management		All Disciplines		http://www.wes.army.mil/el/emrrp/bulletin.html
70	U.S. Army, Corps of Engineers, Ecosystem Management and	October 1999	Overview of stream restoration technology: State of the science		All Disciplines		http://www.wes.army.mil/el/emrrp/bulletin.html

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
71	U.S. Army, Corps of Engineers, Ecosystem Management and	April 1999	Restoration and enhancement of aquatic habitats		Environmental		http://www.wes.army.mil/el/emrrp/bulletin.html
72	U.S. Army, Corps of Engineers, Waterways Experiment Station	October 1997	The WES Stream Investigation and Streambank Stabilization Handbook		Engineering	Hydraulics	U.S. Army, Corps of Engineers, Digital Archive
73	U.S. Army, Corps of Engineers, Costal and Hydraulics Laboratory	September 2001	Hydraulic Design of Stream Restoration Projects		Engineering	Hydraulics	U.S. Army, Corps of Engineers, Digital Archive
74	U.S. Army, Corps of Engineers, Waterways Experiment Station	April 1997	Bioengineering for Streambank Erosion Control		Engineering	Hydraulics	U.S. Army, Corps of Engineers, Digital Archive
75	U.S. Army, Corps of Engineers, Costal and Hydraulics Laboratory	September 2001	Channel Restoration Design for Meandering Rivers		Engineering	Hydraulics	U.S. Army, Corps of Engineers, Digital Archive
76	Federal Agencies	October 1998	Stream Corridor Restoration, Principles, Processes, and Practices		Engineering	Hydraulics	http://www.usda.gov/stream_restoration/newtofc.htm
77	Buckeye Water Conservation & Drainage District	December 11, 2000	Documentation of Continuing Waterlogged Conditions in Buckeye Water Conservation & Drainage District Maricopa County, AZ	Errol L. Montgomery &	Engineering	Groundwater	Stantec
78	City of Avondale	June 1997	Engineering Design Standards		Engineering	Hydraulics	Stantec
79	City of Goodyear	July 22, 1997	Engineering Design Standards and Policies Manual		Engineering	Hydraulics	Stantec
80	Flood Control District of Maricopa County	May, 1999	Salt-Gila River, Floodplain Delineation Restudy, Volume 1 of 5	Baker	Engineering	Hydraulics	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
81	Flood Control District of Maricopa County	May, 1999	Salt-Gila River, Floodplain Delineation Restudy, Volume 2 of 5	Baker	Engineering	Hydraulics	Stantec
82	Flood Control District of Maricopa County	May, 1999	Salt-Gila River, Floodplain Delineation Restudy, Volume 3 of 5	Baker	Engineering	Hydraulics	Stantec
83	Flood Control District of Maricopa County	May, 1999	Salt-Gila River, Floodplain Delineation Restudy, Volume 4 of 5	Baker	Engineering	Hydraulics	Stantec
84	Flood Control District of Maricopa County	May, 1999	Salt-Gila River, Floodplain Delineation Restudy, Volume 5 of 5	Baker	Engineering	Hydraulics	Stantec
85	Flood Control District of Maricopa County	July, 1994	"n" Value Report, Salt-Gila River, Floodplain Delineation Restudy, FCD 92-01	Baker	Engineering	Hydraulics	Stantec
86	Flood Control District of Maricopa County	May, 1999	Flood Delineation Study of Salt-Gila Rivers, FCD No. 90-59 & 92-01, Topographic Work Maps, Sheets 1 through 23A	Baker	Engineering	Hydraulics	Stantec
87	Maricopa County Dept. of Transportation-MCDOT	1996	Bridge Scour Evaluations, Tuthill Road Bridge over the Gila River (Hydraulic Analysis), Preliminary Report	Parsons Brinckerhoff	Engineering	Hydraulics	Stantec
88	Albuquerque Metropolitan Arroyo Flood Control Authority	1983	Erosion Study to Determine Boundaries for Adjacent Development - Calabacillas Arroyo, Bernalillo County, New Mexico	Simons, Li and Assoc.	Engineering	Hydraulics / Sediment	Stantec
89	City of Goodyear	1988	Conceptual Report Cotton Lane Bridge over Gila River	Coe and Van Loo Consult. Eng	Engineering	Hydraulics / Sediment	Stantec
90	Arizona Dept. of Transportation-ADOT	1991	Gila Bend - Buckeye Highway (SR 85) Gila River Bridges : Hydraulic Report	Arizona Dept. of Transportatio	Engineering	Hydraulics / Sediment	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
91	Maricopa County Dept. of Transportation-MCDOT	Revised April 1995	Bridge Hydraulics Report, 116th Avenue Bridge at the Gila River, Appendix B	Simons, Li and Assoc., Inc.	Engineering	Hydraulics / Sediment	Stantec
92	Maricopa County Dept. of Transportation-MCDOT	Revised April 1995	Bridge Hydraulics Report, 116th Avenue Bridge at the Gila River, Appendix D	Simons, Li and Assoc., Inc.	Engineering	Hydraulics / Sediment	Stantec
93	Maricopa County Dept. of Transportation-MCDOT	Revised April 1995	Bridge Hydraulics Report, 116th Avenue Bridge at the Gila River, Appendix E	Simons, Li and Assoc., Inc.	Engineering	Hydraulics / Sediment	Hydraulics / Sediment
94	Flood Control District of Maricopa County-FCD	1998	Bridge Scour Investigation and Design of Corrective Measures, Final Report, Structure Number 8485, Tuthill Bridge over the Gila	Michael Baker Jr. Inc	Engineering	Hydraulics / Sediment	Stantec
95	Florence, Arizona	1989	Gila River Hydrology Analysis	Sunrise Eng. Inc	Engineering	Hydrology	Stantec
96	U. S. Corps of Engineers-COE	1989	Standard Project Flood, Agua Fria River Between the New River Confluence and the Gila River with New Waddell Dam in Place,	U. S. Corps of Engineers-COE	Engineering	Hydrology	Stantec
97	U. S. Corps of Engineers-COE	1995	Agua Fria River Study, New Waddell Dam to Gila River Confluence, Arizona : Hydrologic Evaluation of Impacts of New	U. S. Corps of Engineers-COE	Engineering	Hydrology	Stantec
98	Flood Control District of Maricopa	Revised 1984	Standard Project Flood Analysis and Conceptual Design of Channelization in the Agua Fria River, Final Report	Simons, Li and Assoc. Inc	Engineering	Hydrology / Hydraulics	Stantec
123	U.S. Army Corps of Engineers, Los Angeles District	January 11, 2000	Low Flow Channel Design Analysis for Rio Salado (Salt River), Arizona Technical Appendices (1-3)	West Consultants	Engineering	Hydraulics	Stantec
124	U.S. Army Corps of Engineers, Los Angeles District	January 11, 2000	Low Flow Channel Design Analysis for Rio Salado (Salt River), Arizona Final Report	West Consultants	Hydraulics	Hydraulics	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
125	Town of Buckeye	Feb/March 2000	Town of Buckeye Wastewater Master Plan	David Evans and Associates,	Environmental	Groundwater / Water Quality	Stantec
126	U.S. Army Corps of Engineers, Los Angeles District	December 1981	Central Arizona Water Control Study, Stage III, Final Recreation Planning Report		Planning		Stantec
127	Sub regional Operating Group	March 2001	Salt/Gila Groundwater Analysis Project, Project Number WS90140004-s	Greeley and Hansen	Environmental	Groundwater / Water Quality	Stantec
128	El Rio Stakeholders	9/18/01	El Rio Output of Scope Meeting (Goodyear City Hall)	Timmis & Associates	All Disciplines		Stantec
129	Maricopa County Department of Transportation,	August 1994	Final Environmental Assessment for Gila River Crossing Study (115th Avenue-Estrella Parkway)		Engineering		Stantec
130	Maricopa County Department of Transportation	Revised April 1995	Bridge Hydraulics Report, 116th Avenue Bridge, At The Gila River	Simons, Li & Associates, INC.	Engineering	Hydraulics	Stantec
131	Waterfowl	Spring 1999	Gila River Valley Wetlands Restored to a Nature's Hideaway	Mick St John	Environmental		Stantec
132	U.S. Army Corps of Engineers, Los Angeles District	February 10,1981	Nonstructural Measures Investigations, Phoenix Metro Area / Flood Preparedness Planning		Engineering		Stantec
133	Town Of Buckeye	Fall 1991	The Town of Buckeye, Ecological Inventory and Analysis	Arizona State University	Planning		Stantec
134	Natural Recourses Conservation Service	May 28th, 1997	Fact Sheet Farmland Protection Program		Funding		http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/FPPfact.html

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
135	Natural Recourses Conservation Service	January 22, 2001	Farmland Protection Program, Request for Proposals		Funding		http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/FPP-01.htm
136	Environmental Support Center	02/15/2001	Trails Funding Workshop		Funding		Stantec
137	U.S. Fish and Wildlife Service	February 1998	North American Wetlands Conservation ACT, Small Grants Instructions		Funding		Stantec
138	United States Geological Survey		Southern Part of Gila River Drainage From Texas Hill to Area and Western Mexican Drainage Area (Ground Water Maps)		Environmental	Groundwater	Stantec
139	Flood Control District of Maricopa County	9/27/86	Gila River Cross Sections (SR-85) : Engineering Field Notes 5 Books	Martin Engineering	Engineering		Stantec
140	Journal of Hydraulic Engineering	September 2002	Federal Regulation of Wetlands in Aftermath of Supreme Courts Decision in SWANCC v. United States	Gary E. Freeman & James R.	All Disciplines		Stantec
141	Federal Aviation Administration	5/1/97	Hazardous Wildlife Attractants On OR Near Airports		All Disciplines		Stantec
142	U.S. Army Corps of Engineers, Los Angeles District	September 1997	Water Control Manual, Modified Roosevelt Dam, Salt and Gila Rivers, Arizona		Engineering	Hydrology	Stantec
143	Arizona Department of Water Resources	1991	Second Management Plan (1990-2000) Phoenix Active Management Area.		Environmental	Groundwater	Hydro-LOGIC Consultants
144	Arizona Department of Water Resources	1993	Draft Water Level Elevation Map. (October 1991-February 1992).		Environmental	Groundwater	Hydro-LOGIC Consultants

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
99	U. S. Corps of Engineers-COE	April 2000	Tres Rios, Arizona; Feasibility Study	U. S. Corps of Engineers-COE	Environmental		Stantec
100	Flood Control District of Maricopa County-FCD	1981	Clearing of Phreatophytic Vegetation from the Salt and Gila Rivers 91st Avenue to Gillespie Dam, Draft Environmental Impact	Benham-Blair and Affil.	Environmental	Biological Resources / Tamarisk	Stantec
101	U. S. Geological Survey-USGS	1990	Evaluation of Ground-Water Recharge Along the Gila River as a Result of the Flood of October 1983, In and Near the Gila River	USGS	Hydrology	Ground Water	Stantec
102	Flood Control District of Maricopa County-FCD	1994	A Report on Flooding Damages to the Salt-Gila River, January 1993 Flood	Flood Control District of	Engineering		Stantec
103	Maricopa County Dept. of Transportation-MCDOT	Revised April 1995	Bridge Hydraulics Report, 116th Avenue Bridge at the Gila River, Appendix J	Simons, Li and Assoc., Inc.	Engineering		Stantec
104	U. S. Geological Survey-USGS in Cooperation with Arizona Dept. of	1995	Summary Statistics and Trend Analysis of Water-Quality Data and Sites in the Gila River Basin, New Mexico and Arizona	U. S. Geological Survey	Environmental	Water Quality	Stantec
105	Littlefield, Douglas R.	1998	Assessment of the Navigability of the Gila River from its Confluence with the Salt River to its Mouth on the Colorado River	Littlefield, Douglas R.	All Disciplines		Stantec
106	Maricopa county Department of Transportation Maricopa	Revised June, 1993	A Phase I Archaeological Reconnaissance of 56 Acres for the Gila River- Phoenix International Raceway Bridge Maricopa	Louis Berger & Associates,	Environmental	Archaeology	Stantec
107	Maricopa county Department of Transportation Maricopa	August 1994	Final Environmental Assessment for Gila River Crossing Study (115th Avenue - Estrella Parkway)	MCDOT	Environmental		
108	Luke Air Force Base	From Web Site	General Plan/Luke Air Force Base Contour Map		Planning		Stantec\Web site

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
109	Goodyear Airport	From Web Site	Goodyear Airport Contour Map		Planning		Stantec\Web site
110	City of Goodyear		City of Goodyear Parks, Trails and Open Space Master Plan with Executive Summary		Planning		Stantec
111	City of Avondale Parks and Recreation		Open Space Master Plan		Planning		Stantec
112	City of Avondale		Tres Rios Greenway Specific Plan		Planning		Stantec
113	City of Avondale		"73 El Mirage Property"		Planning		Stantec
114	Maricopa County		Maricopa County Trail Plan		Planning		Stantec
115	Maricopa County	October 1996	Southwest Valley Transportation Study	By BRW	Planning		Stantec
116	Salt River Project		SRP \substation Southwest Valley		Planning		Stantec
117	Town of Buckeye		Waste Water Master Plan		Planning		Stantec
118	Town of Buckeye		Final Traffic Circulation Parking Study		Planning		Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
119	Town of Buckeye		Town of Buckeye Development Code		Planning		Stantec
120	Town of Buckeye	Nov. 2001	Final Report, Buckeye Town Lake Engineering Feasibility Study		Planning		Stantec
121	Luke Air Force Base		Luke Air Force Base General Plan		Planning		Stantec
122	University of Arizona	October 1999	Riparian Ecosystem Restoration in the Gila River Basin: Opportunities and Constraints	Water Resources Research	All Disciplines		http://ag.arizona.edu/AZWATER/publications/proceedings/proceedings.ht
145	Arizona State Land Department Water-Resources Report Number	1966	Infiltration and Recharge from the Flow of April 1965 in the Salt River near Phoenix	Briggs, P.C. and L.L. Werho	Environmental	Groundwater	Hydro-LOGIC Consultants
146	Arizona. USGS Water Resources Investigations Report 88-4202. 5 plates.	1989	Hydrogeology of the Western Part of the Salt River Valley. Maricopa County	Brown, J.G. and D.R. Pool	Environmental	Groundwater	Hydro-LOGIC Consultants
147	Bureau of Reclamation	1976	Central Arizona Project Geology and Groundwater Resources Report Maricopa and Pinal Counties, Arizona, Volumes 1 and		Environmental	Groundwater	Hydro-LOGIC Consultants
148	CLIMAS report series CL1-00	2000	Assessing the Sensitivity of the Southwest's Urban Water Sector to Climate Variability	Carter, Rebecca H, Petra	Environmental	Groundwater	Hydro-LOGIC Consultants
149	Arizona Department of Water Resources, Modeling Report No. 3.	1992	Groundwater Flow and Contaminant Transport Model, Central Phoenix, Maricopa County	Corell, S.W.	Environmental	Groundwater	Hydro-LOGIC Consultants
150	Arizona Department of Water Resources, Phoenix, Arizona, Modeling Report	1994	A Regional Groundwater Flow Model of the Salt River Valley – Phase II Phoenix Active Management Area Numerical Model	Corell, S.W., and E.F. Corkhill	Environmental	Groundwater	Hydro-LOGIC Consultants

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
151	Arizona Department of Water Resources, Phoenix, Arizona, Modeling Report	1993	A Regional Groundwater Flow Model of the Salt River Valley – Phase I, Phoenix Active Management Area Hydrogeologic	Corkhill, E.F., et al	Environmental	Groundwater	Hydro-LOGIC Consultants
152	Arizona Department of Water Resources, Hydrologic Map Series	1992	Maps Showing Groundwater Conditions in the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties	Hammett, B.A. and R.L. Herther	Environmental	Groundwater	Hydro-LOGIC Consultants
153	ADWR unpublished technical memorandum.	1989	Methodology for estimating infiltration volumes for the Salt River from Jointhead Dam to the Buckeye Heading.	Hill, Brad	Environmental	Groundwater	Hydro-LOGIC Consultants
154	ADWR unpublished technical memorandum.	1989	Effluent release data from the City of Phoenix Wasterwater treatment facilities.	Hill, Brad	Environmental	Groundwater	Hydro-LOGIC Consultants
155	Department of Hydrology and Water Resources University of Arizona.	1983	Results of Water-Level Recovery Tests in the Salt River Valley. Unpublished Master's Thesis	Hutton, P.A.	Environmental	Groundwater	Hydro-LOGIC Consultants
156	USGS Water Supply and Irrigation Paper 136, 196p., 2 plates.	1905	The Underground Waters of the Salt River Valley Arizona	Lee, W.T.	Environmental	Groundwater	Hydro-LOGIC Consultants
157	ADWR-Municipal Water Users Association and Irrigation Districts in the	1982	Final Report: Salt River Valley Cooperative Study Modeling Effort.	Long, M.R.	Environmental	Groundwater	Hydro-LOGIC Consultants
158	U.S. Geological Survey Water Resources Investigations Report 83-	1983	Streamflow losses and changes in Groundwater Levels along the Salt and Gila Rivers near Phoenix, Arizona – February	Mann, L.J. and Paul B. Rohne, Jr.	Environmental	Groundwater	Hydro-LOGIC Consultants
159	Reeter, R.W. and W.H. Remick	1986	Maps Showing Groundwater Conditions in the West Salt River, East Salt River, Lake Pleasant, Carefree and Fountain Hills Sub-	Reeter, R.W. and W.H. Remick	Environmental	Groundwater	Hydro-LOGIC Consultants
160	Hydrology Division, Arizona Department of Water Resources.	1983	Incidental and Natural Recharge in the Phoenix Active Management Area	Turner, T.M.	Environmental	Groundwater	Hydro-LOGIC Consultants

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
161	Los Angeles District, South Pacific Division.	1998	Rio Salado Salt River Arizona, Feasibility Report, Technical Appendices.	US Army Corps Of Engineers	Environmental	Groundwater	Hydro-LOGIC Consultants
162	Prepared by Harding Lawson Associates	1997	Groundwater Flow Modeling, West Van Buren WQARF Study Area.	Van Waters and Rogers, Inc.	Environmental	Groundwater	Hydro-LOGIC Consultants
163	Arizona Department of Environmental Quality, unpublished report.	1999	Arizona Department of Environmental Quality Central Phoenix Three-Layer, Transient Groundwater Flow Model	Weston, Roy F., Inc	Environmental	Groundwater	Hydro-LOGIC Consultants
164	Arizona Department of Environmental Quality, unpublished report.	1999	Arizona Department of Environmental Quality Central Phoenix Steady-State Groundwater Flow Model	Weston, Roy F., Inc	Environmental	Groundwater	Hydro-LOGIC Consultants
165	Arizona Department of Environmental Quality, unpublished report.	1998	Arizona Department of Environmental Quality Central Phoenix Groundwater Flow Model Conceptual Model	Weston, Roy F., Inc	Environmental	Groundwater	Hydro-LOGIC Consultants
166	Arizona Department of Environmental Quality, unpublished report.	1997	Arizona Department of Environmental Quality Central Phoenix Groundwater Model: Phase I Database	Weston, Roy F., Inc	Environmental	Groundwater	Hydro-LOGIC Consultants
167	Unpublished Master's Thesis, Department of Hydrology, University of	1995	Recharge and Mixing in Ground Water Along the Lower Salt River, Arizona	Zugay, Eric	Environmental	Groundwater	Hydro-LOGIC Consultants
168	US Fish and Wildlife Service	Dec. 1997	Environmental Contamination in Fish and Wildlife of the Lower Gila River, Arizona	Kirke King et al.	Environmental	Biological Resources	WASS Gerke
169	Sub-Regional Operating Group	Feb. 2001	Middle Gila River Watershed Management Study Phase 2.	Greeley and Hansen	Environmental	Biological Resources	WASS Gerke
170	Arizona Department of Environmental Quality	Sept. 1991	Risk Assessment for Recreation usage of the Painted Rocks Borrow Pit Lake at Gila Bend, Arizona	Arizona Department of Health	Environmental	Biological Resources	WASS Gerke

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
171	University of Arizona Press	1993	Once a River: Bird Life and Habitat Changes on the Middle Gila	Amadeo M. Rea	Environmental	Biological Resources	WASS Gerke
172	City of Phoenix	June 1997	Salt-Gila River Baseline Ecological Characterization.	CH2M Hill	Environmental	Biological Resources	WASS Gerke
173	Arizona Department of Water Resources	Aug. 1999	Stormwater Detention/Retention	ADWR Flood Mitigation	Environmental	Water Quality	WASS Gerke
174	USGS		Streamflow data from Gila River at Estrella Parkway (Station 09514100)		Environmental	Water Quality	http://waterdata.usgs.gov
175	Arizona Meteorological Network		Precipitation and Evapotranspiration Data Buckeye, Arizona		Environmental	Water Quality	http://ag.arizona.edu/azmet/26.htm
176	Maricopa Audubon		Gila River Christmas Bird Count	Troy Corman (602-395-1587)	Environmental	Biological Resources	http://www.maricopaaudubon.org/descript_xmas.htm#gila
177	Wetlands		Establishment of woody riparian vegetation in relation to annual patterns of streamflow, Bill William River, Arizona	Patrick Shafroth et al.	Environmental	Biological Resources	WASS Gerke
178	Wetlands	Dec. 1998	Streamflow requirements for cottonwood seedling recruitment - an integrative model	John Mahoney and Stewart	Environmental	Biological Resources	WASS Gerke
179	Journal of Arid Environments	1992	Response of velvet mesquite to groundwater decline	Juliet Stromberg	Environmental	Vector	WASS Gerke
180	Journal of the Arizona-Nevade Academy of Science	1993	Riparian Mesquite Forests: A review of their ecology, threats, and recovery potential	Juliet Stromberg	Environmental	Biological Resources	WASS Gerke

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
181	Environmental Mangagement	1982	Tamarisk and River-Channel Management	William Graf	Environmental	Biological Resources / Tamarisk	WASS Gerke
182	Wetlands	1998	Functional equivalency of saltcedar and Freemont cottonwood along a free-flowing river	Juliet Stromberg	Environmental	Biological Resources / Tamarisk	WASS Gerke
183	Ecological Applications	1996	Effects of groundwater decline on riparian vegetation of semiarid regions: the San Pedro, Arizona	J. Stromberg and R. Tiller	Environmental	Biological Resources	WASS Gerke
184	Western North American Naturalist	2000	Woody riparian vegetation response to different alluvial water table regimes	Patrick Shafroth et al.	Environmental	Biological Resources	WASS Gerke
185	Journal of the Arizona-Nevade Academy of Science	1993	Frémont cottonwood-gooding willow riparian forests: A review of their ecology, threats, and recovery potential	J.C. Stromberg	Environmental	Biological Resources	WASS Gerke
186	WRP	1994	Effect of vegetation on hydraulic roughness and sedimentation in wetlands		Engineering and Environmental	Hydraulics	WASS Gerke
187	EMRRP	May 2000	Resistance due to vegetation	Craig Fischenich (US	Engineering and Environmental	Hydraulics	WASS Gerke
188	EMRRP	Feb. 2000	Determination of drag coefficients and area for vegetation	Craig Fischenich and Syndi	Engineering and Environmental	Hydraulics	WASS Gerke
189	EMRRP	Apr. 2000	Robert Manning (a historical prospective)	Craig Fischenich	Engineerging	Biological Resources	WASS Gerke
190	Flood Control District of Maricopa County	Jan. 1993	Drainage Design Manual for Maricopa County, Arizona Volume III Erosion Control	Camp Dresser & McKee	Environmental	Biological Resources	WASS Gerke

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
191	Journal of Arid Environments	1998	Dynamics of Freemont cottonwood and saltcedar populations along the San Pedro River, Arizona	J. Stromberg	Environmental	Biological Resources / Tamarisk	WASS Gerke
192	Great Basin Naturalist	1995	Effects of Salinity on Establishment of Populus Freemontii and Tamarix Ramosissima in the southwestern United	Patrick Shafroth et al.	Environmental	Biological Resources / Tamarisk	WASS Gerke
193	Desert Plants	1984	Observations of seeds and seedlings of Fremont wottonwood	Pattie Fenner et al.	Environmental	Biological Resources	WASS Gerke
333							
335	U.S. Army Corps of Engineers, Los Angeles District	1982	Gila River Basin; New River and Phoenix City Streams, Arizona	USACE	Engineering	Hydrology	Stantec
194	Rivers	Jul. 1991	Flood Flows and Dynamics of Sonoran Riparian Forests	J. Stromberg et al.	Environmental	Biological Resources	WASS Gerke
195	Weed Technology	1998	Saltcedar (Tamarix sp.) management with imazapyr	K.W. Duncan and K.C.	Environmental	Biological Resources / Tamarisk	WASS Gerke
196	Ecosystem restoration of Gila River Basin Proceedings	1999	Large Scale Removal of Saltcedar Monocultures prior to restoration with native vegetation	K.C. McDaniel and J.P.	Environmental	Biological Resources / Tamarisk	WASS Gerke
197	Weed Technology	1998	Restoration of saltcedar (Tamarisk sp.) infested floodplains on the Bosque del Apache National Wildlife Refuge	J.P. Taylor and K.C. McDaniel	Environmental	Biological Resources / Tamarisk	WASS Gerke
198	Maricopa Association of Governments	Oct. 2002	208 Water Quality Management Plan	Carollo Engineers	Environmental	Water Quality	WASS Gerke

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
199	Discovery Park	2002	Water requirements of native vegetation used in restoration	Ted St. John	Environmental	Biological Resources	WASS Gerke
200	American Mosquito Control Association	1981	Identification and Geographical Distribution of the Mosquitoes of North America North of Mexico	Darsie/Ward	Environmental	Vector	AC&T
201	California Mosquito and Vector Control Association	1990	Epidemiology and Control of Mosquito-Borne Arboviruses in California, 1943-1987	Reeves	Environmental	Vector	AC&T
202	University of Florida	1997	Florida Mosquito Control Handbook	Evans	Environmental	Vector	AC&T
203	City of Phoenix	1999	A Mosquito Control Strategy for the Tres Rios Demonstration Constructed Wetlands Final Report, July 1999	CH2M Hill	Environmental	Vector	AC&T
204	University of Nevada	1966	The Mosquitoes of Nevada	Chapman	Environmental	Vector	AC&T
205	University of Arizona	1973	Mosquitoes of Arizona	McDonald	Environmental	Vector	AC&T
206	University of Utah	1961	An Identification Guide to the Mosquitoes of Utah	Nielsen; Rees	Environmental	Vector	AC&T
207	Richmond Publishing Co.	NA	Mosquitoes	Snow	Environmental	Vector	AC&T
208	Florida Medical Entomology Laboratory	1988	Habitat Management for the Control of Wastewater Culex Mosquitoes	O'Meara; Mook; Larson	Environmental	Vector	AC&T

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
209	Colusa Mosquito Abatement District	1997	Wetland Development and Management Guidelines for the Control of Mosquitoes	NA	Environmental	Vector	AC&T
210	Arizona State University		Arizona Climate Summary	NA	Environmental	Vector	AC&T
211	Chapman and Hall (pub.)	1995	The Chironomidae. Biology and Ecology of Non-biting Midges	Armitage; Cranston; Pinder	Environmental	Vector	AC&T
212	Notre Dame University	1946	The Mosquitoes of the Southern United States	Carpenter	Environmental	Vector	AC&T
213	J. Allergy and Immunology	1984	Lake Fly Allergy: Incidence of Chironomid Sensitivity in an Atopic Population	Kagen et al.	Environmental	Vector	AC&T
214	EPA	1993	The First Lake Maintenance Handbook	McComas	Environmental	Vector	AC&T
215	Univ. California Berkely	1978	Mosquitoes of California	Bohart	Environmental	Vector	AC&T
216	ADHS	2000-2002	Arizona Department of Health Services Arbovirus Monthly Updates	Levy; Fink	Environmental	Vector	AC&T
217	Maricopa County	2002	Maricopa County Vector Control-personal communication	John Townsend	Environmental	Vector	AC&T
218	Stantec	2002	El Rio Mosquito Monitoring	AC&T	Environmental	Vector	AC&T

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
219	City of Phoenix	1996	City Of Phoenix Vector and Midge Control Program Index S-933861	AC&T	Environmental	Vector	AC&T
220	City of Phoenix	1997	Tres Rios Demonstration Constructed Wetland Project, 1996/1997 Operation & Water Quality Report	Wass	Environmental	Vector	AC&T
221	City of Phoenix	1997	Tres Rios Mosquito Monitoring Summary 1997	Wass	Environmental	Vector	AC&T
222	City of Phoenix	1998	Tres Rios Mosquito Monitoring Summary 1998	Wass	Environmental	Vector	AC&T
223	City of Phoenix	Sep 1998-Apr1999	Tres Rios Demonstration Wetland Mosquito Data	AC&T	Environmental	Vector	AC&T
224	City of Phoenix	Jan-Mar 2000	Tres Rios Demonstration Wetland Mosquito Monitoring Report	AC&T	Environmental	Vector	AC&T
225	City of Phoenix	Apr-Jul 2000	Tres Rios Demonstration Wetland Mosquito Monitoring Report	AC&T	Environmental	Vector	AC&T
226	City of Phoenix	Aug-Sept 2000	Tres Rios Demonstration Wetland Mosquito Monitoring Report	AC&T	Environmental	Vector	AC&T
227	City of Phoenix	Oct-Dec 2000	Tres Rios Demonstration Wetland Mosquito Monitoring Report	AC&T	Environmental	Vector	AC&T
228	City of Phoenix	Feb-Jul 2000	Holly Acres Mosquito Monitoring Report	AC&T	Environmental	Vector	AC&T

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
229	City of Phoenix	Aug-Dec 2000	Holly Acres Mosquito Monitoring Report	AC&T	Environmental	Vector	AC&T
230	City of Phoenix	Jan-Aug 2001	Tres Rios Constructed Demonstration Wetlands Mosquito Monitoring Summary	AC&T	Environmental	Vector	AC&T
231	City of Phoenix	Sept-Dec 2001	Tres Rios Constructed Demonstration Wetlands Mosquito Monitoring Summary	AC&T	Environmental	Vector	AC&T
232	City of Phoenix	Mar-02	Tres Rios Demonstration Constructed Wetland Mosquito Monitoring Annual Summary 2001	AC&T	Environmental	Vector	AC&T
233	City of Phoenix	Apr-Jul 2000	Baseline Mosquito Monitoring Summary Phoenix Rio Salado	AC&T	Environmental	Vector	AC&T
234	City of Phoenix	Aug-Dec 2000	Baseline Mosquito Monitoring Summary Phoenix Rio Salado	AC&T	Environmental	Vector	AC&T
235	City of Phoenix	Jan-Aug 2001	Baseline Mosquito Monitoring Summary Phoenix Rio Salado	AC&T	Environmental	Vector	AC&T
236	City of Phoenix	Sep-Dec 2001	Baseline Mosquito Monitoring Summary Phoenix Rio Salado	AC&T	Environmental	Vector	AC&T
237	City of Phoenix	Jan-Aug 2001	Holly Acres Mosquito Monitoring Summary	AC&T	Environmental	Vector	AC&T
238	City of Phoenix	Sept-Dec 2001	Holly Acres Mosquito Monitoring Annual Summary 2001	AC&T	Environmental	Vector	AC&T

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
239	Wilson & Co./City of Phoenix	2001	Initial Vector Surveilance Cave Buttes Recreational Area	AC&T	Environmental	Vector	AC&T
240	Lewis Publishers	1990	Constructed Wetlands for Wastewater Treatment	Hammer	Environmental	Vector	AC&T
241	USEPA, OW	1990	The Lake and Reservoir Restoration Guidance Manual	USEPA	Environmental	Vector	AC&T
242	USEPA, OW	1993	Restoration and Management of Lakes and Reservoirs	Cooke et al.	Environmental	Vector	AC&T
243	Thomas Publications	1986	Freshwater Vegetation Management	Gangstad	Environmental	Vector	AC&T
244	University of Arizona	2002	Constructed Wetland Technology and Mosquito Populations in Arizona	Karpisak et al.	Environmental	Vector	AC&T
245	City of Phoenix	1996	91st Avenue Vector and Midge Control Program	AC&T	Environmental	Vector	AC&T
246	Purdue University	1997	Indiana Commercial Pesticide Applicator Training Manual	Lembi	Environmental	Vector	AC&T
247	USEPA, ORD	2000	Constructed Wetlands Treatment of Municipal Wastewaters	USEPA	Environmental	Vector	AC&T
248	University of Kentucky	1997	Midges and Gnats	Townsend	Environmental	Vector	AC&T

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
249	Florida Dept. Health and Rehabilitation Services	1990	Guidelines for Controlling Mosquitoes in Water Retention/Detention Areas	O'Meara et al.	Environmental	Vector	AC&T
250	Arizona State University	1997	The downstream impacts of the Gillespie Dam breach on the lower Gila River	Cygnia Freeland	Environmental	Biological Resources	EcoPlan Associates
251	Arizona State University	1996	Native riparian vegetation of the lower Salt and middle Gila rivers: status and restoration	Douglas F. Corkran	Environmental	Biological Resources	EcoPlan Associates
252	Arizona State University	1988	Dynamics of bird species assemblages along a climatic gradient: a Grinnellian Niche approach	William C. Hunt	Environmental	Biological Resources	EcoPlan Associates
253	Arizona State University	1994	The use of landscape ecology to create planning options for river corridor management	Anna Margret Hersperger	Environmental	Biological Resources	EcoPlan Associates
254	Arizona State University	December, 1993	Hassayampa River Preserve, Wickenburg, Arizona: flora, vegetation, flood impact, and riparian herbaceous understory restoration.	Lynn Glick Wolden	Environmental	Biological Resources	EcoPlan Associates
255	National Park Service	1987	Ecology and management of riparian breeding birds in tamarisk habitats along the Colorado River in Grand Canyon National	Brown, Bryan T. and R. Roy	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
256	National Park Service	1987	Status of tamarisk and its control in Grand Canyon National Park	Sharrow, David	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
257	National Park Service	1987	Summary report on Tamarix chinensis lour. at Organ Pipe Cactus National Monument	Mikus, Bill	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
258	National Park Service	1987	Status of saltcedar (Tamarix ramosissima) within Glen Canyon National Recreation Area	Holland, James	Environmental	Biological Resources / Tamarisk	EcoPlan Associates

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
259	National Park Service	1987	Tamarisk control project: Petrified Forest National Park	Bowman, Carl	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
260	U.S. Fish and Wildlife Service	1987	Saltcedar control for wildlife habitat improvement in the southwestern United States	Theodore A. Kerpez	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
261	U.S. Department of Interior	1989	Results of biological investigations from the lower Virgin River vegetation management study	Bureau of Reclamation	Environmental	Biological Resources	EcoPlan Associates
263		1994	Trial and Error: Assessing the Effectiveness of Riparian Revegetation in Arizona	Briggs, Roundy, and Shaw	Environmental	Biological Resources	EcoPlan Associates
264	Revegetation and Wildlife Management Center	1995	Salt Cedar, Revegetation and Riparian Ecosystems in the Southwest	Bertin W. Anerson	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
265	Northern Arizona University	1974	Population Structure and Social Organization of Southwestern Riparian Birds.	Steven W. Carothers and others	Environmental	Biological Resources	EcoPlan Associates
266	University of Nevada	1996	Salt Cedar Eradication and Native Revegetation of a Desert Riaprian Area: The Pilot Study of the Hidden Valley Dairy Salt	Kevin Clarke and Robert M. Nelson	Planning	Biological Resources / Tamarisk	EcoPlan Associates
267	U.S. Fish and Wildlife Service	1996	Saltcedar Leaf Beetle	C.Jack DeLoach	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
268	Arizona Game and Fish Department	1923	Rallus longirostris yumanensis	D.R. Dickey	Environmental	Biological Resources	EcoPlan Associates
269	Western Forest and Conservation Nursery Association	2001	Riparian Restoration in the Southwest - species selection, propagation, planting methods, and case studies.	David Dreesen and others	Environmental	Biological Resources	EcoPlan Associates

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
270	Gila Indian River Community and the Department of	2001	Vegetation Communities of the Gila River Wetlands, Within the Gila River Indian Community	EcoPlan	Environmental	Biological Resources	EcoPlan Associates
271	Gila Indian River Community and the Department of	2002	Fish Sampling Results for the Ecological Characterization of the Gila River Wetlands, Gila River Indian Community	EcoPlan	Environmental	Biological Resources	EcoPlan Associates
272	Gila Indian River Community and the Department of	2002	Bird Survey Results for the Ecological Characterization of the Gila River Wetlands, Gila River Indian Community	EcoPlan	Environmental	Biological Resources	EcoPlan Associates
273	U.S. Environmental Protection Agency	2002	Phoenix - Goodyear Airport Area	EPA	Environmental		EcoPlan Associates
274	Environmental Management	1982	Tamarisk and River-channel Management	William L. Graf	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
275		1999	Invasive Species in the Southwest: Tamarix sp. (Saltcedar)	Jason Hart	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
276	U.S. Department of Interior	2002	Santa Ana Pueble Restores Stretch of Rio Grande River	Ben Ikenson	Planning		EcoPlan Associates
277	Bureau of Land Management	2002	Conservation Priorities in Naturally Fragmented and Human-altered Riparian Habitats of the Arid West.	David J. Kruefer	Environmental	Biological Resources	EcoPlan Associates
278	City of Phoenix	1997	Salt-Gila River Baseline Ecological Characterization	Logan, Simpson, and Dye, and	Environmental	Biological Resources	EcoPlan Associates
279	North American Journal of Fisheries Management	1982	Fishes of the Phoenix Metropolitan Area in Central Arizona.	Paul C. Marsh and W. L.	Environmental	Biological Resources	EcoPlan Associates

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
280	University of Minnesota Department of Horticultural Science	1998	Riparian Restoration in the Arid American West: Reversing the Spread of Tamarisk	Candace McCown	Environmental	Biological Resources / Tamarisk	EcoPlan Associates
281	Texas Parks and Wildlife Department	2002	General Guidelines for Woody Plantings Used to Restore/Enhance Riparian Zones in the High Plains	Gene T. Miller	Environmental	Biological Resources	EcoPlan Associates
282	Partners for Fish and Wildlife Program	2001	New Mexico	Chuck Mullins	Planning		EcoPlan Associates
283	U.S. Department of Agriculture, Forest Service	2002	Watershed Management for Endangered Aquatic and Riparian Species: Facts and Fallacies	D.G. Neary and others	Environmental	Biological Resources	EcoPlan Associates
284	Wright and Sielaty, ChemReg Int'l	2001	Union Calendar No. 355, 107th Congress	Hefley and others	All Disciplines		EcoPlan Associates
285	Chesapeake Bay Foundation	2001	Riparian Restoration	Elizabeth Norris	Environmental, Planning	Biological Resources	EcoPlan Associates
286	U.S. Department of Interior	2002	Environmental Assessment for Saltcedar Treatment within the Clover Mountains Wilderness Study Area	Karen L. Prentice	Environmental	Biological Resources	EcoPlan Associates
287	DesertUSA	2002	Our Vanishing Riparian Landscapes	Jay W. Sharp	Environmental	Biological Resources	EcoPlan Associates
288	Oregon State University	2002	Riparian Areas	Dr. Clinton C. Shock	Environmental	Biological Resources	EcoPlan Associates
289	U.S. Geological Survey	2001	Southwestern Willow Flycatcher Breeding Site and Territroy Summary 2000	Mark K. Sogge and others	Environmental	Biological Resources	EcoPlan Associates

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
290	U.S. Geological Survey	2002	Riparian Ecosystem Creation and Restoration		Environmental	Biological Resources	EcoPlan Associates
291	Arizona Game and Fish Department	2002	Freemont Cottonwood (Populus fremontii)	Wade A. Zarlingo	Environmental	Biological Resources	EcoPlan Associates
292	Soil Conservation Service	1977	Soil Survey of Maricopa County, Arizona Central Part	Hartman, G.W., et al.	Engineering	Geomorphology	JEF
293	Arizona Geological Survey	1997	Digital Representation of the Geological Map of the Phoenix South 30' x 60' Quadrangle, Central Arizona, Digital	Reynolds, S.J., et al.	Engineering	Geomorphology	JEF
294	Arizona Geological Survey	1989	Geologic map of Quaternary and upper Tertiary alluvium in the Phoenix South 30' x 60' quadrangle, Arizona (revised August	Demsey, K.A.	Engineering	Geomorphology	JEF
295	ASU	1988	The Salt and Gila Rivers in Central Arizona, A Geographic Field Trip Guide	Graf, W. L. ed.	Engineering	Geomorphology	JEF
296	Grassland, Soil and Water Research Laboratory	undated	Diorhabda elongata- "salt Cedar Leaf Beetle"	Dr. C Jack DeLoach	Environmental	Biological Resources / Tamarisk	Stantec
297	Federal Register US Fish and Wildlife Service	Nov. 29, 2002	Notice of Availablility of Final Environmental Impact Statement and Final Roosevelt Habitat Conservation Plan for	Geoffrey L. Haskett	Environmental	Mitigation	Stantec
298	Federal Register US Fish and Wildlife Service	Dec-2002	Final Environmental Impact Statement for the Roosevelt Habitat Conservation Plan Gila and Maricopa Counties	US Fish and Wildlife Service	Environmental	Mitigation	Stantec
299	Montana War on Weeds	Feb 25 2002	Diorhabda elongata- saltcedar leaf beetle	Kyle Simons and Carl Lanz	Environmental	Biological Resources / Tamarisk	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
300	High Country News	25-May-1998	Tackling Tamarisk Vol 30, Issue 10	Paul Larmer	Environmental	Biological Resources / Tamarisk	Stantec
301	USDepartment Agriculture	11-Nov-2001	Host Specificity of a leaf beetle, diorhabda Elongata deserticola (Coleoptera: Chrysomelidae) from asia, for gbiologicvl	DeLoach JR, Culver J; Lewis,	Environmental	Biological Resources / Tamarisk	Stantec
302	USDA	undated	Life History of Diorhabda elongata in Secure Field Cages: Results of Research during Stage A of Research Releases in 1999	Juli Gould et al.	Environmental	Biological Resources / Tamarisk	Stantec
303	National Park Service	1999	Saltcedar Tamarix aphylla, T. chinensis, T. gallica, T. parviflora, and T. ramosissima	Muzika, Rose-Marie; Swearingen,	Environmental	Biological Resources / Tamarisk	Stantec
304		Dec. 10, 2001	Preference and growth by Diorhabda elongata (coleoptera:chrysomelidae) in response to target plant (Tamarix parviflora)	Dudley, Tom, et al	Environmental	Biological Resources / Tamarisk	Stantec
305	J Range Management	April 15 2000	Reflectance and Image Characteristics of Selected Noxious Rangeland Species	Everitt, JH et al	Environmental	Biological Resources / Tamarisk	Stantec
306	Grand Canyon River Guides Association	undated	Scourge of the West: The Natural History of Tamarisk in the Grand Canyon	Larry Stevens	Environmental	Biological Resources / Tamarisk	Stantec
307	The Arizona Riparian Council 1997 Vol. 10, No. 1	1997	The Value of Saltcedar to Nesting Southwestern Riparian Birds.	William J. Howe	Environmental	Biological Resou	Stantec
308	AZ Game and Fish	2002	Arizona state list of special status species	AZ Game and Fish	Environmental	Biological Resou	Stantec
309	US Fish Wildlife Service	2002	The Federal list of protected species	US Fish Wildlife Service	Environmental	Biological Resou	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
310	Flood Control District of Maricopa County-FCD		Executive Summary; The El Rio Vision		All Disciplines		Stantec
311	U.S. Army Corps of Engineers, Los Angeles District	April 1997	Tres Rios, Arizona Reconnaissance Report		All Disciplines		Stantec
332		March 18, 2005	Control of Tamarix in the Wastern United States: Implications for Water Slavage, Wildlife Use, and Riparian Restoration	Shafroth et. Al.	Environmental	Biological Resources / Tamarisk	Stantec
334	U.S. Army Corps of Engineers, Los Angeles District	February, 1979	Flood Damage Survey, Phoenix, Arizona, 28 Februray- 6 March 1978	USACE	Engineering	Hydrology	Stantec
312	Maricopa county Department of Transportation	April 1, 1996	Tuthill Road Bridge Over the Gila River, Bridge Scour Evaluations	Parsons Brinckerhoff	Engineering	Hydraulics / Sediment	Stantec
313	The Secretary of the Army	November 2, 1959	Gila and Salt Rivers, Gillespie Dam to McDowell Dam Site , Arizona		All Disciplines		Stantec
314	United States Department of Agriculture		A Geography of Hope	NRCS	All Disciplines		Stantec
315	United States Department of Agriculture	December 1999	Arizona Farm Bill Report	NRCS	All Disciplines		Stantec
316	Kimely-Horn	December 1996	Draft Sediment Trend Analysis, Salt River between Granite Reef Dam and the confluence with the Gila River	Kimely-Horn	Engineering	Sediment	Stantec
317	Town of Buckeye	Spring 1992	Buckeye Vision Plan	ASU Planning Department	Planning		Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
318	United States Department of Agriculture	May 2000	Resource Conservation and Development	NRCS	All Disciplines		Stantec
319	United States Geological Survey	August 1955	Compliation of Flood Data in Arizoan; 1862-1953	Winchell Smith & Wilbur L.	Engineering	Hydrology	Stantec
320	Flood Control District of Maricopa County		Wetlands for Water Quality Enhancement		Environmental	Water Quality	Stantec
321	Sun City Home Owners Association	May 1997	Composition of Surface Waters of the Watersheds of the Salt and Gila Rivers Influencing the West Salt River Valley	E.C Dapples	Environmental	Water Quality	Stantec
322	Flood Control District of Maricopa County		Dentention Basins for Water Quality Enhancement		Environmental	Water Quality	Stantec
323	Flood Control District of Maricopa County	August 1981	Final Report, Salt-Gila River Interim Flood Contol Works, Drawings, Gillespie Dam to the Agua Fria River	CDM	Engineering	Engineering	Stantec
324	Flood Control District of Maricopa County	June 12, 1981	Draft Final Report, Salt-Gila River Interim Flood Contol Works, Gillespie Dam to the Agua Fria River, Appendix	CDM	Engineering	Engineering	Stantec
325	Flood Control District of Maricopa County	June 12, 1981	Draft Final Report, Salt-Gila River Interim Flood Contol Works, Gillespie Dam to the Agua Fria River	CDM	Engineering	Engineering	Stantec
326	Central Arizona Water Control Study, U.S. Army Corps of Engineers, Los	July 24, 1980	Preliminary Hydraulic Design Memorandum	CDM	Engineering	Engineering	Stantec
327	Agricultural & Resource Economics, University of Arizona	January, 2002	Riparian Areas Generate Property Value Premium for Landowners	Dr. Bonnie Colby	Engineering	Engineering	Stantec

ID	Owner	Reference Date	Reference	Author	Discipline Use	Sub Discipline	Location
328	Flood Control District of Maricopa County	May 2003	Sand and Gravel Mining Guidelines, Floodplain Use Permit Application	FCDMC	Engineering	Engineering	Stantec
329	West Consultants	September 13,2004	Prelimiminary HEC-6T Models of King Ranch Area	WEST	Engineering	Engineering	Stantec
330	Maricopa County Department of Transportation	May 30,2005	Draft Cotton Lane Bridge Conceptual Habitat Mitigation, Monitoring, and Maintenance Plan	EcoPlan	Environmental		Stantec
331	Arizona State University	August 2004	Aggressive Measures Towards Controlling Saltcedar (Tamarix ramosissima) in the Southwestern United States	Jason William Long	Environmental	Biological Resources / Tamarisk	Stantec

ATTACHMENT 2:

Environmental Planning Data Collection Synopsis

Environmental Planning Data Collection Synopsis

Anderson, Bertin W. 1995. Salt Cedar, Revegetation and Riparian Ecosystems in the Southwest. Revegetation and Wildlife Management Center. Blythe, CA.

Tamarisk is seemingly better suited to the abiotic soil conditions of many southwestern river systems, likely due to practices of man such as irrigation, dam building, channelization, etc. Due to the fact that present conditions favor this exotic species, removal of tamarisk and revegetation with native species often fails. It is unlikely that such efforts could permanently eradicate tamarisk because it is better suited to the existing soils and hydrologic regimes than native vegetation. In select areas where conditions favor native vegetation, removal of tamarisk and revegetation with native species can be successful and can provide preferable wildlife habitat.

Bowman, Carl. 1987. 1987. Tamarisk control project: Petrified Forest National Park. In Tamarisk control in southwestern United States: proceedings of Tamarisk Conference, University of Arizona, Tucson, Arizona, September 2 and 3, 1987. National Park Service and University of Arizona, Tucson, Arizona.

Youth Conservation Corps volunteer crews cut tamarisk plants in the Petrified Forest National Park in 1987. The stumps were treated with Garlon 3A, a pesticide to prevent re-growth. The efforts were fairly unsuccessful, with only a 21% kill rate. Efforts resulted in trampling of surrounding vegetation, and loss of shade resulted in browning and wilting of some surrounding vegetation. Herbicide application was done during summer, when many plants may be dormant, possibly reducing the effectiveness of the chemical. Effectiveness of Garlon 3A in tamarisk control is uncertain, according to the results of this study.

Briggs, Mark K., Bruce A. Roundy, and William W. Shaw. 1994. Trial and Error: Assessing the Effectiveness of Riparian Revegetation in Arizona. In Restoration and Management Notes. Volume 12:2, Winter 1994.

The various effects of human development on the Southwest have resulted in the degradation of riparian ecosystems. Concern for riparian communities has resulted in the creation of restoration programs that have been used throughout the state. The authors did follow-up research on 27 riparian restoration projects in a variety of Arizona habitats to determine long-term success. Successful restoration projects considered factors contributing to degradation of riparian sites: decline in ground water, animal and non-native plant competition, instability of channels, and increase in soil salinity. If secondary mitigation measures are employed to address site degradation (i.e. changes in land-use, digging to water table, removal of non-native vegetation, irrigation, etc.), restoration projects are more likely to be successful.

Brown, Bryan T. and R. Roy Johnson. 1987. Ecology and management of riparian breeding birds in tamarisk habitats along the Colorado River in Grand Canyon National Park, Arizona. In Tamarisk control in southwestern United States: proceedings of Tamarisk Conference, University of Arizona, Tucson, Arizona, September 2 and 3, 1987. National Park Service and University of Arizona, Tucson, Arizona.

This paper discusses different types of tamarisk habitats throughout the state, and the types and use of these habitats by wildlife. Bird density and diversity varies greatly depending upon additional species within habitat blocks. Management strategies to control tamarisk for breeding birds are discussed. Although tamarisk is considered a pest species, it is an important resource for nesting birds in Grand Canyon National Park, especially at higher elevation sites. Management of riparian bird species diversity in tamarisk communities requires a designed strategy to be successful.

Bureau of Reclamation. 1989. Results of biological investigations from the lower Virgin River vegetation management study. U.S. Department of the Interior, Denver.

Tamarisk is considered to be the cause of many problems in Southwest riparian systems, including high water consumption, salt concentration, impeding flood streams, and degradation of wildlife habitat. A vegetation management study was carried out on a 600-acre parcel of tamarisk habitat on the Lower Virgin River in Nevada. The area was a monotypic area dominated by multi-stemmed, shrubby tamarisk. Studies indicate that permanent resident birds, such as song sparrows and Abert's towhees, occurred at higher densities year-round than did summer resident, migratory or wintering species. Increase in native riparian marsh plants within tamarisk habitat increased densities of wetland bird species, indicating that restoration of native habitat increases suitability of riparian habitat for wildlife.

Carothers, Steven W., R. Roy Johnson, and Stewart W. Aitchison. 1974. Population Structure and Social Organization of Southwestern Riparian Birds. American Zoologist, Vol. 14, Pages 97-108.

This paper illustrates differences in species diversity, abundance, and overall health based on the habitat type along riparian woodland habitats. Riparian corridors dominated with cottonwood and bordered by agricultural fields rendered the greatest number of breeding pairs, which also obtained the largest average weight. The authors attribute these differences the productivity of the adjacent habitat and the extent of competition between and among the adjacent avian populations. This paper is precise and the outcome could potentially be recreated, therefore, it becomes a valuable tool for restoration efforts.

Clarke, Kevin and Robert M. Nelson. 1996. Salt Cedar Eradication and Native Revegetation of a Desert Riparian Area: The Pilot Study of the Hidden Valley Dairy Salt Cedar Eradication Project. Master's Thesis, University of Nevada.

The article introduces the problematic salt cedar in the Southwestern states and explains the methodology conducted to eliminate the plant on the Muddy River, Nevada. A description of the plant's history and how it made it into the region provide a background for why native riparian areas are conducive to its growth. The half mile study corridor underwent eradication of salt cedar and revegetation with native desert riparian species over a five month period. However, no results of the study were provided.

Corkran, Douglas F. 1996. Native riparian vegetation of the lower Salt and middle Gila rivers: status and restoration. Master's Thesis, Arizona State University.

This document covers an area much larger than the project area, but has specific information for two segments of the project area. Vegetation transects were done for this thesis, two of which are in the project area. Document includes vegetation community maps and discussions of vegetation composition of these areas. Vegetation in the area, in 1994, consisted mainly of tamarisk communities, with some mesquite thickets, and one area of cottonwoods.

DeLoach, C. Jack. 1996. Saltcedar Leaf Beetle. United States Fish and Wildlife Service.

Diorabda elongata is the first natural enemy approved for release as a biological control agent of saltcedar in the U.S. The article provides information on the would-be-introduced-beetle, to eradicate salt cedar populations. The biological control agent is known to only feed on salt cedar plants. This background information would provide a valuable alternative for eradication of salt cedar.

Dickey, D. R. 1923. Rallus longirostris yumanensis. Arizona Game and Fish Department Heritage Data Management System.

Classification, nomenclature, description, and range of the Yuma Clapper Rail. Provides a description of the species, its range, general biology, population trends, and habitat components. Is a good source for identifying breeding, foraging, or dispersal information for this listed (endangered) species.

Dreesen, David, John Harrington, Tom Subirge, Pete Stewart, and Greg Fenchel. 2001. Riparian restoration in the Southwest - species selection, propagation, planting methods, and case studies. Proceedings of the Western Forest and Conservation Nursery Association Meeting.

Article discusses the value of riparian plant communities, though small in overall area, to Southwestern ecosystems and the causes of degradation. It outlines the goals of riparian restoration and the plant species and stock types which should be selected for restoration

efforts. Also discussed are the relevant site characteristics and vegetative propagation methodologies. Case studies are also presented on the restoration of the cottonwood forests along the middle Rio Grande and Gila River and of montane riparian areas in the Apache-Sitgreaves National Forests. This article will be valuable as a guide for any riparian restoration, which may take place within the corridor.

EcoPlan Associates, Inc. 2001. Vegetation Communities of the Gila River Wetlands, Within the Gila River Indian Community, Arizona. Department of Environmental Quality.

The ecological characterization prepared on behalf of the Gila River Indian Community and the Department of Environmental Quality provides on-site data for a 2-mile segment of the Gila River and approximately 1-mile of the Salt, prior to its confluence with the Gila. The methodology for mapping the vegetative communities is discussed and a description of the study area provides an overview of the existing terrain and features. This document illustrates species density, diversity, and spatial patterns and is valuable for the proposed project as background data of existing resource conditions.

EcoPlan Associates, Inc. 2002. Fish Sampling Results for the Ecological Characterization of the Gila River Wetlands, Gila River Indian Community, Arizona. Department of Environmental Quality.

The ecological characterization prepared on behalf of the Gila River Indian Community and the Department of Environmental Quality provides on-site data for a 2-mile segment of the Gila River and approximately 1-mile of the Salt, prior to its confluence with the Gila. Methodology, species identification, comparative analysis, and suggestions for improving habitat are discussed. This document is valuable for the proposed project as background data of existing resource conditions.

EcoPlan Associates, Inc. 2002. Bird Survey Results for the Ecological Characterization of the Gila River Wetlands, Gila River Indian Community, Arizona. Department of Environmental Quality.

The ecological characterization prepared on behalf of the Gila River Indian Community and the Department of Environmental Quality provides on-site data for a 2-mile segment of the Gila River and approximately 1-mile of the Salt, prior to its confluence with the Gila. Methodology, transect identifiers, and results and discussion, and comparison of data with nearby areas of similar habitat are included. This document is valuable for the proposed project as background data of existing resource conditions.

Environmental Protection Agency. 2002. Phoenix – Goodyear Airport Area. United States Environmental Protection Agency.

This web announcement overviews threats and contaminants (solvents and chromium) in the groundwater at the Phoenix – Goodyear Airport. Sampling of wells by the Arizona Department of Health Services revealed contamination in several wells. Environmentally, the contamination presents risks to the riparian habitat along the lower Gila River and would be serious to species/birds that use the Gila as a migration corridor or for nesting. This article is important for background/baseline data of present conditions along the proposed project corridor and for identifying potential problem areas during restoration and construction.

Freeland, Cygnia. 1997. The downstream impacts of the Gillespie Dam breach on the lower Gila River. Master's Thesis, Arizona State University.

This document covers impacts downstream of the project area, but has a short discussion of habitat above State Route 85, within the project area. In the early 1980's, clearing activities took place in the project area. A straighter path for water flow was created, but flood events have since recreated the meandering channel, and tamarisk has regrown to create thickets.

Graf, William L. 1982. Tamarisk and River-channel Management. Environmental Management.

Discusses the invasive aspect of this plant and notes the plants as the most common riparian inhabitant. First appearing on the Salt and Gila around 1890, it eventually posed serious problems for flood control. The ensuing density of the tamarisk communities diminished the capacity of major river channels. The paper further outlines control measures that were evaluated based on their potential to impede the spread of tamarisk. Of five control efforts, two may return the desired goal: a reduction in groundwater table, which may cause the shallow, rooted salt cedar to be limited in distribution, and/or flood control, which would be manipulated to decrease water flows during the plants primary germination stages. The article is valuable to the proposed project because the study area is incorporated.

Hart, Jason. 1999. Invasive Species in the Southwest: *Tamarix* sp. (Salt Cedar).

The author introduces invasive species by giving examples from around the nation. A brief history regarding the introduction of tamarix into the U.S. is followed by general biological facts about the plant. The author discusses four main impacts tamarix has on the local environment, once the species becomes established: 1) soil salinity increases, 2) ground water consumption is increased, 3) wildfires become more frequent, and 4) flooding intensity and occurrence increases. As other authors have done, Hart explains factors that contribute to the on-going survival of the species and how to manage and restore vegetative communities.

Hersperger, Anna Margret. 1994. The use of landscape ecology to create planning options for river corridor management. Master's Thesis, Arizona State University.

This document discusses possible landscape ecology planning contexts and their effectiveness for a tamarix-infested corridor along the Gila River. A portion of the corridor discussed is within the project area. According to the author, tamarisk uses more water than native riparian vegetation, and tamarisk infestation results in an increase of sedimentation. The species has dramatic effects on wildlife, and on flooding potential.

Holland, James. 1987. Status of saltcedar (*Tamarix ramosissima*) within Glen Canyon National Recreation Area. In Tamarisk control in southwestern United States: proceedings of Tamarisk Conference, University of Arizona, Tucson, Arizona, September 2 and 3, 1987. National Park Service and University of Arizona, Tucson, Arizona.

This paper discusses the current condition of riparian ecology, in regards to the status of tamarisk and the potential for reestablishing a more natural riparian community. Techniques for removing tamarisk and preventing further infestation are discussed. The author suggests use of the shoreline areas of Lake Powell for experimental development of riparian vegetative communities.

Hunter, William C. 1988. Dynamics of bird species assemblages along a climatic gradient: a Grinnellian Niche approach, by. Master's Thesis, Arizona State University.

This document discusses bird sampling and monitoring at four sites along the Gila River. One site is located within the project area. Vegetation characteristics, including foliage density and species composition, are discussed. Species densities for various bird species in specific habitat types are outlined. Insectivorous species had the highest density and greatest species diversity, followed by game bird species and cavity nesters. Raptors were the least common species with the lowest density. Verdins, warblers, and towhees were among the most common species.

Ikenson, Ben. 2002. Santa Ana Pueblo Restores Stretch of Rio Grande River. Department of Interior.

Launched in 1997, several projects were designed to enhance the Rio Grande and its floodplain. The tribe and the Bureau of Reclamation modified channel characteristics for two-miles of the river's west bank within the reservation. The Bureau of Indian Affairs, the Environmental Protection Agency, and the U.S. Fish and Wildlife Service helped fund the Pueblo's restoration efforts. Restoration of the east bank is forthcoming and more plans for other parts of the river are underway. This article is valuable to the proposed project because it could serve as an example of an ongoing successful riparian restoration project.

Kerpez, Theodore A. 1987. Saltcedar control for wildlife habitat improvement in the southwestern United States. Resource publication / United States Department of the Interior, Fish and Wildlife Service: no. 169. Washington D.C.

This document recommends that land managers fully assess the problems created by tamarisk invasion, and consider all possible solutions before implementing control measures. To be

effective, control measures should include removal at the root crown with supplemental herbicide treatment and prevention from reinvasion. Revegetation with native plants aids in preventing reinvasion.

Kruefer, David J. 2002. Conservation Priorities in Naturally Fragmented and Human-altered Riparian Habitats of the Arid West. Bureau of Land Management.

The article provides an overview of western riparian habitats and suggests viewing issues in terms of modern conservation principles. A conservation strategy and mechanism for implementation should be developed and traditional management should be evaluated and amended. The author concentrates on conservation and preservation of riparian ecosystems and their dependent avian assemblages. He redefines management principles and urges a conservation approach geared toward preservation and restoration to the maximum extent. He encourages involvement by all interested or affected parties because human needs and desires supercede ecosystem management. Evaluation of traditional thought is key to changing the dynamics in ecosystem management.

Logan, Simpson, & Dye, and EcoPlan Associates, Inc. 1997. Salt-Gila River Baseline Ecological Characterization. City of Phoenix.

The document was prepared to address the permitting issues relevant to discharges of effluent wastewater into the Salt River. A literature review, a quantitative ecological characterization (incorporating wildlife and vegetation occurrence), and mapping analysis from 75th Avenue to the Buckeye Diversion Dam were conducted. Key constituents include: the elements of the project area, climate, flow, water quality, vegetation communities, aquatic species, avian diversity, and soil contaminants. This document discusses numerous documents that have been written regarding the biotic and abiotic factors present in the Salt River corridor in the central Phoenix area. The abundant information exemplifies the efforts that have already been taken to document and study the Salt River in the metropolitan Phoenix area.

Marsh, Paul C. and W. L. Minckley. 1982. Fishes of the Phoenix Metropolitan Area in Central Arizona. North American Journal of Fisheries Management.

Due to changing water resources in the metropolitan area of central Arizona, namely the Salt River, the native fish fauna has greatly changed. The once desert river with high groundwater has become a dry wash with a low water table. Historically, 15 species of fish were native, now only 4 persist (in their natural range) and 29 non-native species have been documented to occur in their place. The paper provides an account of the species of fish, records of occurrence, and status. Major modifications to aquatic habitat are to blame for the loss of surface waters. This article provides evidence that human alteration of habitat has serious consequences.

McCown, Candace. 1998. Riparian Restoration in the Arid American West: Reversing the Spread of Tamarisk. University of Minnesota Department of Horticultural Science.

This article discusses the spread of the salt cedar (Tamarix spp.) in the Arid American West along the Rio Grande and the problems for the riparian biota it has caused. It also discusses the characteristics and value of the native riparian forests and the efforts to return the riparian communities to their natural state. This article provides some valuable insight into the history of the spread of salt cedar and the value of returning if possible to a native riparian vegetative community.

Mikus, Bill. 1987. Summary report on *Tamarix chinensis lour.* at Organ Pipe Cactus National Monument. In Tamarisk control in southwestern United States: proceedings of Tamarisk Conference, University of Arizona, Tucson, Arizona, September 2 and 3, 1987. National Park Service and University of Arizona, Tucson, Arizona.

Tamarisk is uncommon in the Organ Pipe Cactus National Monument, due to high temperatures and the general absence of perennial water. Water is present in areas where the water table is higher, namely Quitobaquito Springs and Aguajito Wash. In these areas, tamarisk has invaded, but is not dominant. Past efforts to control the species included hand removal with shovels and axes. As of 1987, when the paper was written, other control measures had not been employed, but chemical treatment for large tamarisk scattered throughout the monument was planned.

Miller, Gene T. General Guidelines for Woody Plantings Used to Restore/Enhance Riparian Zones in the High Plains. Texas Parks and Wildlife Department.

The document was developed for those planning to restore or enhance native woody vegetation. State and Federal incentive program guidelines were incorporated into this compilation on how to revegetate. The author covers the establishment of the overstory (providing input on spacing between trees and distance from water), the fruiting midstory component, and understory shrubs. The article contains recommendations that could assist in maximizing the efforts of revegetation. This article provides a starting point and baseline information for any proposed revegetation.

Mullins, Chuck. July 2001. New Mexico. Partners for Fish and Wildlife Program.

The author begins with a general description of the state of the Partners for Fish and Wildlife Program in New Mexico. He identifies a concentration to create, restore, and enhance special habitats, such as riparian areas and wetlands. A basic inventory of species that can be found in the state and potential threats to their existence ensues. Strategies to restore habitats are evidenced in current plans by the Partners Programs to recreate lost habitat. The article concludes by listing potential habitat restoration areas.

Neary, D.G., J. N. Rinne, A. L. Medina, M. B. Baker, Jr., and J. L. Michael. March 2002. Watershed Management for Endangered Aquatic and Riparian Species: Facts and Fallacies. United States Department of Agriculture Forest Service.

The authors address watershed politics. They question the efforts of single species management and ecosystem restoration. The article begins by introducing the complexity

of river basin management. Legislation and litigation seek to protect the threatened and endangered wildlife that utilize riparian habitats. These highly complex ecosystems are not completely understood and contributing factors that make the riparian system so dynamic need to be tested in the context of watershed management.

Norris, Elizabeth M. 2001. Riparian Restoration. Chesapeake Bay Foundation.

The article appeared in The Wetlands Program Technical Report and describes ecological attributes important to the wildlife of riparian ecosystems (1-cover, 2-surface water, 3-habitat diversity, 4-migration and dispersal corridors). It further discusses the economic, social, and biological values riparian ecosystems offer; and the causes of riparian degradation. Restoration of the riparian corridor buffer begins with landscape ecology, technology, vegetation mapping and analyses, and management through voluntary and contractual programs. This article contributes a general and basic understanding of how degradation occurs and a basis for how to reverse it.

Prentice, Karen L. 2002. Environmental Assessment for Salt Cedar Treatment within the Clover Mountains Wilderness Study Area. United States Department of Interior.

This document discusses the use of Garlon 4 as chemical herbicide to eradicate salt cedar within the Clover Mountains Wilderness Study Area in Nevada. The objectives to be accomplished include: increasing wilderness values by preserving natural conditions; protecting the value and character of the wilderness; and demonstrating that chemical control is necessary for effective eradication of salt cedar. The document also evaluates alternative actions for eradication and addresses impacts to the environment for all considered actions. The assessment is a thorough investigation of the impacts that invasive species have on natural environments, the options for eradication, and cumulative impacts of the intended action. It represents all the impacts of a project specific action.

Shafroth, Patrick B., Tellman, Barbara, Briggs, Mark K. 1999. Riparian Ecosystem Restoration in the Gila River Basin: Opportunities and Constraints. Water Resources Research Center.

This publication documents the content of a workshop held in April 1999 on riparian ecosystem restoration in the Gila River Basin. The purpose is to more effectively plan, implement, and manage riparian restoration projects. The workshop discussions include: lessons gained from past recovery efforts; considerations of the problems and possibilities for restoration efforts; monitoring and assessment methods; restoration of native vegetation; watershed improvement; and case studies. This document is pertinent since it contains information specific to the project area.

Sharrow, David. 1987. Status of tamarisk and its control in Grand Canyon National Park. In Tamarisk control in southwestern United States: proceedings of Tamarisk

Conference, University of Arizona, Tucson, Arizona, September 2 and 3, 1987. National Park Service and University of Arizona, Tucson, Arizona.

Tamarisk has invaded riparian streamside vegetation, roadsides and waste areas, and sandy terraces along the Colorado River in the Grand Canyon National Park. This paper describes the problem of tamarisk invasion and control efforts within the park to minimize the expansion of the species. The National Park Service is dedicated to preserving the natural ecosystems, but recognizes the importance of tamarisk to riparian wildlife species. The National Park Service is attempting to control the tamarisk invasion through selected removal and herbicidal treatment, but does not intend to completely eradicate the species.

Sharp, Jay W. 2002. Our Vanishing Riparian Landscapes. DesertUSA.

A discussion of early settlement impacts on the riparian environments begins the article. Historic accounts describe once turbulent waters with an abundance of wildlife. The author then educates the reader regarding general drainage patterns in the Southwest. Once the background is complete, the results of stream modification and use accounts for the loss of many of the natural characteristics of riparian ecosystems are presented. Consequences of modification and use are offered prior to soliciting input on whether or not it is possible to restore balance to these systems.

Shock, Clinton C., Dr. 2002. Riparian Areas. Malheur Agricultural Experiment Station, Oregon State University.

The compilation describes riparian areas and identifies functions of a healthy system. It also outlines management principles and recommends strategies that should be developed with interdisciplinary goals in mind. The author suggests tailoring management to the specific site, comparing and assessing current with desired conditions, designing goals that can be achieved, implementing the plan, and monitoring, evaluating, and modifying as necessary.

Sogge, Mark K., Susan J. Sferra, Tracy McCarthey, Sartor O. Williams, III, and Barbara E. Kus. 2001. Southwestern Willow Flycatcher Breeding Site and Territory Summary - 2000. United States Geological Survey.

Summarizes survey efforts for the listed (endangered) species. Efforts to identify all breeding sites and assemble data for the species was conducted and documented from 1993 until 2000 and is published in this document. The authors outline the parameters and define terms. They compile and present data in a precise and concise manner. Territories, population and distribution estimates, elevational ranges, and percentage of use of habitat types are some of the details included. This document is species specific and can be helpful in determining what factors of vegetation type/cover would retain populations of the listed bird.

United States Geological Survey. 2002. Riparian Ecosystem Creation and Restoration: A Literature Summary.

This article discusses the status of Riparian Ecosystems in the United States. It attributes the causes of destruction primarily due to man's activities, summarizing examples of the consequences faced by utilizing water in riparian corridors. This article provides a very basic introduction of why riparian corridors are in the condition they are in.

Wolden, Lynn Glick. December 1993. Hassayampa River Preserve, Wickenburg, Arizona: flora, vegetation, flood impact, and riparian herbaceous understory restoration. Master's Thesis, Arizona State University.

This document provides a vegetation characterization and analysis of an area with similar characteristics to the project area. The report discusses plot treatments done to evaluate potential to eradicate exotic plant species. The report also evaluates flood impact on herbaceous vegetation. Studies in the area indicate that after flood events, species diversity increased, and tamarisk reinfestation declined. Human removal of exotic species such as tamarisk was generally ineffective in controlling plant communities.

Zarlingo, Wade A. 2002. Fremont Cottonwood (Populus fremontii). Arizona Game and Fish Department.

The article is an overview of the ecology of the cottonwood tree and outlines its habitat, distribution, biology, and status. The article identifies management needs to ensure that the species is present in riparian habitats in the future.

ATTACHMENT 3:

Agency Interview Summaries

AGENCY ISSUES AND CONCERNS

Bureau Of Land Management

Interviewer: Tim Wade, Senior Biologist, EcoPlan Associates, Inc.

BLM Representatives: Don Charpio, Assistant Field Manager, Region VI
Gene Dahlem

- Any riparian restoration projects undertaken need to result in a proper functioning riparian system, which meets the needs of the wildlife in the area.

- Although salt cedar is a non-native and may not be the desired tree for riparian zones, it does provide extensive blocks of wildlife habitat. Given the current conditions along this reach of the Gila River salt cedar may be the appropriate vegetation for this area.

- BLM is open to discussion on any restoration effort but will not be able to take the lead either financially or manpower wise. They will however assist with analysis and NEPA process.

- The BLM does not want any increase in motorized vehicular access.

- BLM would not support efforts to construct any type of visitor center or informational kiosk on their property.

- Any projects implemented on BLM lands must not result in a reduced benefit to wildlife.

- BLM would like to see any trail system developed double as a fire suppression trail system. There is a need for increased access in some portions of the reach to support fire suppression efforts.

- If there is an increase in public access to the corridor, it should be limited to walk-in or equestrian access only. Any increase in vehicular access will result in more dumping and increase the potential for fire.

- They would like to ensure that the El Rio Project Managers and any other appropriate individuals on the team comment on the ongoing BLM Phoenix South Resource Management Plan. This plan will take in the El Rio Project area. Scoping for the plan will occur in February 2003.

AGENCY ISSUES AND CONCERNS

Arizona Game and Fish Department

Interviewer: Tim Wade, Senior Biologist, EcoPlan Associates, Inc.

AGFD Representatives: Russell Haughey, Habitat Program Manager, Region VI
Tom Hildebrandt, Wildlife Program Manager, Region VI

- Riparian restoration projects are often unsuccessful due to lack of proper site analysis, planning and unrealistic expectations. (See article titled "Trial and Error, Assessing the Effectiveness of Riparian Revegetation in Arizona)

- The Arizona Game and Fish (Department) has concerns regarding the lack of success of previous riparian restoration projects in this vicinity. Habitat mitigation for the 1,000' clearance and the New River channelization projects, as well as for other types of projects have been largely unsuccessful due to a wide variety of reasons. Considering the important wildlife and habitat resources at stake, this history does not foster confidence that a project on a larger scale will be any more successful.

- Rather than focusing on in-stream and flood channel alterations to meet flood protection objectives, the Department would like the Maricopa County Flood Control District (MCFCD) to pursue acquisition of properties likely to become damaged by flooding and preservation of open space as the primary strategy to reduce property damage from flooding. This is a more efficient use of funds rather than dedicating them to restoration, which may not be successful.

- What happens if the restoration aspects of the plan fail? In particular, the Department is concerned that if attempts to replace salt cedar with native riparian plants fail, habitat values of the site will then be degraded from their previous condition. The Department would like to see contingency plans detailed to ensure no-net loss of habitat values.

- Due to the significant uncertainty regarding the probable success of replacing salt cedar with native riparian vegetation, the Department would like the MCFCD to test the methodology on small plots. Then, if these sites are successful, then we would be more comfortable with expanding the scope of the native riparian restoration effort.

- Although salt cedar is a non-native and not the desired tree for riparian zones, it does provide extensive blocks of wildlife habitat. Salt cedar provides extensive nesting habitat for white-winged and mourning doves, as well as many other species of birds. Removal will create a net loss of currently utilized habitat.

- Replacement of salt cedar with native species such as willow and cottonwood, as well as velvet and screw-bean mesquite, is probably an unrealistic expectation for most sites. Current flow regimes and soil conditions in many places (salinity especially) do not support the ability of natives to out-compete salt cedar and grow to maturity. Analysis of current vegetation in the study area supports this opinion. Where cottonwoods have germinated, especially since the floods of 1993, they are stunted and not thriving. Willows similarly seem to establish well, but experience high mortality (ca. 50%) and ultimately fail except directly adjacent to flowing channels.

- Any attempt to plant native riparian species should be preceded by a complete analysis of the soil and subsurface moisture at the proposed site, followed by a critical analysis of the suitability of the site for the intended species.

- The Department will only support projects that can be implemented with a no net loss of wildlife habitat, diversity and density.

- Any projects implemented on AGFD deeded or managed lands must increase habitat values and be consistent with the purposes for which the property was acquired or is managed.

- Any areas within the corridor that contain cattail stands are potential Yuma Clapper Rail habitat.

- The entire corridor is potential habitat for Yellow-billed Cuckoo and Southwestern Willow Flycatcher.

- Fish production in the watered areas of the corridor is among the highest in the state. As a result, fish eating birds thrive throughout the corridor. It is vital that any aspect of the project not negatively impact their nesting and foraging areas.

- Areas on and around the John Beaver property are important white-winged dove nesting habitat and must be preserved.

- Wildlife-related recreation opportunities such as bird watching and hunting (where legal) need to be preserved.

- If there is an increase in public access to the corridor, it should be limited to walk-in or equestrian access only. Any increase in vehicular access will result in more dumping and increase the potential for fire.

- Access points should be dispersed to avoid concentrating activity.

- The Department would like to see wildlife migration corridors maintained.

AGENCY ISSUES AND CONCERNS

Arizona Game and Fish Department

Interviewer: Tim Wade, Senior Biologist, EcoPlan Associates, Inc.

AGFD Representative: Bill Werner, Aquatics Program Manager, Habitat Branch

- Although salt cedar is a non-native and not the desired tree for riparian zones, it can provide extensive blocks of wildlife habitat. Removal of stands of salt cedar that have no or little habitat value does not create a net loss of habitat and is acceptable. See report by Anderson and Ohmart[1] for a description of wildlife use and densities in riparian tree communities, including salt cedar. Note also that Southwestern Willow Flycatcher have been documented nesting in salt cedar under specific conditions, a factor which must be considered in planning and implementing any revegetation project involving removal of salt cedar.

- Removal of salt cedar and enhancement of a cottonwood/willow stands, which appear to be sustaining themselves but are starting to be crowded out by salt cedar, is a viable strategy. There needs to be sufficient site specific soil testing and analysis of present and future water regimes to be successful.

- It is unrealistic and not a natural condition to expect to have habitat from bank to bank on a river corridor. All rivers have a portion between the banks that is devoid of vegetation. In perennial rivers this portion is open water. In desert rivers this may be sand or cobble or other normally dry substrate.

- The reach just east of the 115th Avenue Bridge can be used as a reference reach for the Gila River in the project area. It was used by the Tres Rio Project due to its longevity and typical conditions.

- Activities such as bird watching, hiking, equestrian use and other passive activities are possible future uses of the corridor. Hunting opportunities will be reduced as the cities along the corridor annex county land. Fishing is a viable activity also, however water quality must be improved before fishing in the corridor can be encouraged by public entities. Fishing opportunities, which are supported by water other than from the river itself, may allow for fish consumption by avoiding contaminant issues.

- Acquisition or exchange of lands within the corridor to block up and maintain a river corridor is encouraged to allow the river to support habitat and still provide

---

[1] Anderson, B.W. and R.D. Ohmart. 1977. Wildlife use and densities report of birds and mammals in the lower Colorado River valley. Bureau of Reclamation Lower Colorado Region Contract No. 7-07-30-V0009. 355pp.

for flood control and prevent encroachment. Encroachment into the flood plain reduces options for planners. Maintenance of "green infrastructure" should be promoted, i.e. taking care of the river as infrastructure so that it functions for flood conveyance, habitat, recreation etc. The river corridor should be as wide as can be accomplished. Uses within that corridor which can withstand flooding would not necessarily be inconsistent.

- Removal of salt cedar from around existing cotton/willow stands has shown to be a viable method to increase vitality of the cottonwood/willow stand.

- In areas where beaver are present population control methods or protection of trees will be necessary to protect native riparian vegetation. Preferred foods will be the first to be eaten by the beavers.

- A holistic approach to management of the river corridor is necessary to reduce O & M costs and provide for multi-use recreation.

- Restoration projects need to be self -sustaining.

- There should be a thorough analysis of how the system is functioning now and why it is functioning as such. This information will provide guidance for any enhancement or restoration activities. Enhancement or restoration needs to be realistic given the current setting and conditions.

- Look for opportunities for the establishment of mesquite bosques on the bench areas. These can be self-sustaining once established.

- Ensure that restoration occurs in areas that will not be negatively impacted by fairly frequent flooding such as a five-year event.

- Try to include Waterman Wash in the project. Changes in the wash's flow regime may negatively affect sediment transport and sediment characteristics of main channel.

- Drainage wells may provide additional water for restoration/enhancement opportunities.

- Understanding the future water regime of the river is vital to this project. Water conditions in the future may change drastically as surrounding land is transitioned from agriculture to residential use or wastewater is diverted to other uses.

- Explore opportunities for land exchanges within the project area.

- Gravel operations could be useful in removing material to accomplish certain tasks such as reestablishment of a low-flow channel or open water areas.

- Pothole areas should be linked to provide a linear contiguous habitat within the corridor.

AGENCY ISSUES AND CONCERNS

Maricopa County Parks and Recreation Department

Interviewer: Tim Wade, Senior Biologist, EcoPlan Associates, Inc.

MCP&R Representatives: Bill VanAusdal, Deputy Director and Chief of Park Police
Molly Garrett, Estrella Mountain Park Supervisor
John Gunn, Spur Cross Ranch Park Supervisor

- Opportunity area exists near Bullard Avenue within the Estrella Mountain Park (Park) boundaries. There is standing water present and stands of willow on islands and sandbars and also an abundance of wildlife. If enhanced, area could provide opportunities for wildlife viewing and an interpretive center.

- The Maricopa County Parks and Recreation Department (MCP&R) sees the El Rio project as an opportunity to enhance passive outdoor recreation in and adjacent to the park. They also feel that as opportunities for conservation and wildlife oriented recreation increase, so will the visitation from conservation-minded individuals. These types of Park visitors will assist in preserving the area and keeping it free of trash and vandalism.

- MCP&R is are opposed to establishing and maintaining a 1000 foot clear zone if it means a loss of habitat and negatively impacting the natural beauty which exists now within and adjacent to the Park.

- There should be minimal structural flood control methods used. Instead the river should be allowed to meander within the flood plain.

- Intensity of development whether it be residential, commercial or recreation oriented needs to be carefully evaluated to ensure minimal negative impacts to the corridor.

- If a trail system is developed it should be as natural as possible and not allow motorized vehicular access. Trails, which are accessable to handicapped persons, should not be paved but surfaced with decomposed granite.

- If lake recreation is developed, no motorized vessels should be allowed. Electric motors could possibly be allowed but that should be fully analyzed first.

- Wildcat landfills should be cleaned up, especially upstream. MCP&R could assist in any clean-up efforts which are proposed, especially if they occurred upstream of the Park.

- If possible equestrian users should be kept out of the river bottom and up on the bench and separated from hikers and bikers due to past conflicts between these user groups. Access to water could be accomplished through limited access trails to open water and/or watering troughs.

- Various open water reaches and potholes should be connected to create a continuous band of open water and associated edge, understory and overstory habitat.

- MCP&R would like to receive a copy of any reports produced as the project progresses. Also, Molly Garrett would like to be added to the list of agency representatives and be invited to attend any stakeholder meetings held.

AGENCY ISSUES AND CONCERNS

U.S. Fish and Wildlife Service

Interviewer: Tim Wade Senior Biologist, EcoPlan Associates Inc.

USFWS Representative: Michael A. Martinez, Fish & Wildlife Biologist

- Their primary concern is the endangered species in the corridor and their associated suitable habitat, specifically the Southwestern Willow Flycatcher and the Yuma Clapper Rail.

- A nesting pair of flycatchers was discovered at the Tres Rio area just upstream from the El Rio project are this year. It is quite possible that there are also nesting pairs in the project area.

- Yellow-billed Cuckoo need to be considered also even though it is only at this point a candidate species. It status as "warranted but precluded" could change depending upon future actions.

- The entire corridor is potential habitat for Yellow-billed Cuckoo and Southwestern Willow Flycatcher.

- Although salt cedar is a non-native and not the desired tree for riparian zones, it does provide extensive blocks of wildlife habitat. Removal will create a net loss of currently utilized habitat.

- Restoration related projects should result with not only no net loss of wildlife habitat, diversity and densities but an improvement.

- It is vital that any aspect of the project not negatively impact fish eating birds and/or their nesting and foraging areas.

- Money should be spent on acquiring lands within the corridor to allow the river to remain as it is and still provide for flood control. This is a more efficient use of funds rather than expending them on restoration, which may or may not be successful.

- Upstream activities, both current and in the future, need to be factored into any proposed mitigation or restoration project to assist in ensuring long term success.

- Opportunities for endangered fish recovery actions need to be explored. An example would be the creation of backwaters to be used for endangered fish refugia.

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

2224 W. Desert Cove Ave.
Suite 209
Phoenix, AZ 85029
(602) 870-2081

19 November 2002

Mr. Tim Wade
Eco Plan & Associates
701 W Southern Ave Suite 209
Mesa, AZ 85210

Re: Federal Aviation Administration guidelines.

Dear Mr. Tim Wade,

Thank you for the opportunity to comment on the riparian restoration project planned along the areas east of the Goodyear airport. I am writing in response to your concerns expressed during our phone conversation on Monday 18 November, 2002 pertaining to Federal Aviation Administration (FAA) recommendations and guidelines.

Without a copy of the design plans for your riparian restoration project it is very difficult to make recommendations and/or suggestions to assist you in reaching your project goals. I have included FAA Advisory Circular No. 150/5200-33 for your review.

WS continues to agree with FAA guidelines which state, Wetland Mitigation should be designed so it does not create a wildlife hazard (Advisory Circular 150/5200-33 1-4. b. and land use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife- aircraft collisions.

Once again, thank you for the opportunity to comment on the riparian restoration project to occur near the Goodyear airport. USDA WS looks forward to contributing professional advice, recommendations and information related to the success of environmental restoration projects in conjunction with the safety of airports and their passengers. If you have any questions and/or comments please contact either myself or Mr. David Bergman, Arizona WS State Director, at Area Code (602) 870-2081.

Sincerely,
Michael A Pacheco
Michael A Pacheco
Wildlife Biologist
USDA APHIS WS

C: Kevin Flynn
Bill Long
Ed Cleary
Anne Quigley
David Bergman
Krista Wenning

U.S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS

Date: 5/1/97
Initiated by: AAS-310 and APP-600

AC No: 150/5200-33
Change:

1. **PURPOSE.** This advisory circular (AC) provides guidance on locating certain land uses having the potential to attract hazardous wildlife to or in the vicinity of public-use airports. It also provides guidance concerning the placement of new airport development projects (including airport construction, expansion, and renovation) pertaining to aircraft movement in the vicinity of hazardous wildlife attractants. Appendix 1 provides definitions of terms used in this AC.

2. **APPLICATION.** The standards, practices, and suggestions contained in this AC are recommended by the Federal Aviation Administration (FAA) for use by the operators and sponsors of all public-use airports. In addition, the standards, practices, and suggestions contained in this AC are recommended by the FAA as guidance for land use planners, operators, and developers of projects, facilities, and activities on or near airports.

3. **BACKGROUND.** Populations of many species of wildlife have increased markedly in the last few years. Some of these species are able to adapt to human-made environments, such as exist on and around airports. The increase in wildlife populations, the use of larger turbine engines, the increased use of twin-engine aircraft, and the increase in air-traffic, all combine to increase the risk, frequency, and potential severity of wildlife-aircraft collisions.

Most public-use airports have large tracts of open, unimproved land that are desirable for added margins of safety and noise mitigation. These areas can present potential hazards to aviation because they often attract hazardous wildlife. During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives world-wide, as well as billions of dollars worth of aircraft damage. Hazardous wildlife attractants near airports could jeopardize future airport expansion because of safety considerations.

DAVID L. BENNETT
Director, Office of Airport Safety and Standards

SECTION 1. HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

1-1. TYPES OF HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS. Human-made or natural areas, such as poorly-drained areas, retention ponds, roosting habitats on buildings, landscaping, putrescible-waste disposal operations, wastewater treatment plants, agricultural or aquacultural activities, surface mining, or wetlands, may be used by wildlife for escape, feeding, loafing, or reproduction. Wildlife use of areas within an airport's approach or departure airspace, aircraft movement areas, loading ramps, or aircraft parking areas may cause conditions hazardous to aircraft safety.

All species of wildlife can pose a threat to aircraft safety. However, some species are more commonly involved in aircraft strikes than others. Table 1 lists the wildlife groups commonly reported as being involved in damaging strikes to U.S. aircraft from 1993 to 1995.

Table 1. Wildlife Groups Involved in Damaging Strikes to Civilian Aircraft, USA, 1993-1995.

Wildlife Groups	Percent involvement in reported damaging strikes
Gulls	28
Waterfowl	28
Raptors	11
Doves	6
Vultures	5
Blackbirds-Starlings	5
Corvids	3
Wading birds	3
Deer	11
Canids	1

1-2. LAND USE PRACTICES. Land use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife-aircraft collisions. FAA recommends against land use practices, within the siting criteria stated in 1-3, that attract or sustain populations of hazardous wildlife within the vicinity of airports or cause movement of hazardous wildlife onto, into, or across the approach or departure airspace, aircraft movement area, loading ramps, or aircraft parking area of airports.

Airport operators, sponsors, planners, and land use developers should consider whether proposed land uses, including new airport development projects, would increase the wildlife hazard. Caution should be exercised to ensure that land use practices on or near airports do not enhance the attractiveness of the area to hazardous wildlife.

1-3. SITING CRITERIA. FAA recommends separations when siting any of the wildlife attractants mentioned in Section 2 or when planning new airport development projects to accommodate aircraft movement. The distance between an airport's aircraft movement areas, loading ramps, or aircraft parking areas and the wildlife attractant should be as follows:

a. Airports serving piston-powered aircraft. A distance of 5,000 feet is recommended.

b. Airports serving turbine-powered aircraft. A distance of 10,000 feet is recommended.

c. Approach or Departure airspace. A distance of 5 statute miles is recommended, if the wildlife attractant may cause hazardous wildlife movement into or across the approach or departure airspace.

SECTION 2. LAND USES THAT ARE INCOMPATIBLE WITH SAFE AIRPORT OPERATIONS.

2-1. GENERAL. The wildlife species and the size of the populations attracted to the airport environment are highly variable and may depend on several factors, including land-use practices on or near the airport. It is important to identify those land use practices in the airport area that attract hazardous wildlife. This section discusses land use practices known to threaten aviation safety.

2-2. PUTRESCIBLE-WASTE DISPOSAL OPERATIONS. Putrescible-waste disposal operations are known to attract large numbers of wildlife that are hazardous to aircraft. Because of this, these operations, when located within the separations identified in the sitting criteria in 1-3 are considered incompatible with safe airport operations.

FAA recommends against locating putrescible-waste disposal operations inside the separations identified in the siting criteria mentioned above. FAA also recommends against new airport development projects that would increase the number of aircraft operations or that would accommodate larger or faster aircraft, near putrescible-waste disposal operations located within the separations identified in the siting criteria in 1-3.

2-3. WASTEWATER TREATMENT FACILITIES. Wastewater treatment facilities and associated settling ponds often attract large numbers of wildlife that can pose a threat to aircraft safety when they are located on or near an airport.

a. New wastewater treatment facilities. FAA recommends against the construction of new wastewater treatment facilities or associated settling ponds within the separations identified in the siting criteria in 1-3. During the siting analysis for wastewater treatment facilities, the potential to attract hazardous wildlife should be considered if an airport is in the vicinity of a proposed site. Airport operators should voice their opposition to such sitings. In addition, they should consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

b. Existing wastewater treatment facilities. FAA recommends correcting any wildlife hazards arising from existing wastewater treatment facilities located on or near airports without delay, using appropriate wildlife hazard mitigation techniques. Accordingly, measures to minimize hazardous wildlife attraction should be developed in consultation with a wildlife damage management biologist. FAA recommends that wastewater treatment facility operators incorporate appropriate wildlife hazard mitigation techniques into their operating practices. Airport operators also should encourage those operators to incorporate these mitigation techniques in their operating practices.

c. Artificial marshes. Waste-water treatment facilities may create artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by some species of flocking birds, such as blackbirds and waterfowl, for breeding or roosting activities. FAA recommends against establishing artificial marshes within the separations identified in the siting criteria stated in 1-3.

d. Wastewater discharge and sludge disposal. FAA recommends against the discharge of wastewater or sludge on airport property. Regular spraying of wastewater or sludge disposal on unpaved areas may improve soil moisture and quality. The resultant turf growth requires more frequent mowing, which in turn may mutilate or flush insects or small animals and produce straw. The maimed or flushed organisms and the straw can attract hazardous wildlife and jeopardize aviation safety. In addition, the improved turf may attract grazing wildlife such as deer and geese.

Problems may also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

e. Underwater waste discharges. The underwater discharge of any food waste, e.g., fish processing offal, that could attract scavenging wildlife is not recommended within the separations identified in the siting criteria in 1-3.

2-4. WETLANDS.

a. Wetlands on or near Airports.

(1) Existing Airports. Normally, wetlands are attractive to many wildlife species. Airport operators with wetlands located on or nearby airport property should be alert to any wildlife use or habitat changes in these areas that could affect safe aircraft operations.

(2) Airport Development. When practicable, the FAA recommends siting new airports using the separations identified in the siting criteria in 1-3. Where alternative sites are not practicable or when expanding existing airports in or near wetlands, the wildlife hazards should be evaluated and minimized through a wildlife management plan prepared by a wildlife damage management biologist, in consultation with the U.S. Fish and Wildlife Service (USFWS) and the U.S. Army Corps of Engineers (COE).

NOTE: If questions exist as to whether or not an area would qualify as a wetland, contact the U.S. Army COE, the Natural Resource Conservation Service, or a wetland consultant certified to delineate wetlands.

b. Wetland mitigation.

Mitigation may be necessary when unavoidable wetland disturbances result from new airport development projects. Wetland mitigation should be designed so it does not create a wildlife hazard.

(1) FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in the siting criteria in 1-3. Wetland mitigation banks meeting these siting criteria offer an ecologically sound approach to mitigation in these situations.

(2) Exceptions to locating mitigation activities outside the separations identified in the siting criteria in 1-3 may be considered if the affected wetlands provide unique ecological functions, such as critical habitat for threatened or endangered species or ground water recharge. Such mitigation must be compatible with safe airport operations. Enhancing such mitigation areas to attract hazardous wildlife should be avoided. On-site mitigation plans may be reviewed by the FAA to determine compatibility with safe airport operations.

(3) Wetland mitigation projects that are needed to protect unique wetland functions (see 2-4.b.(2)), and that must be located in the siting criteria in 1-3 should be identified and evaluated by a wildlife damage management biologist before implementing the mitigation. A wildlife damage management plan should be developed to reduce the wildlife hazards.

NOTE: AC 150/5000-3, *Address List for Regional Airports Division and Airports District/Field Offices*, provides information on the location of these offices.

2-5. DREDGE SPOIL CONTAINMENT AREAS. FAA recommends against locating dredge spoil containment areas within the separations identified in the siting criteria in 1-3, if the spoil contains material that would attract hazardous wildlife.

SECTION 3. LAND USES THAT MAY BE COMPATIBLE WITH SAFE AIRPORT OPERATIONS.

3-1. GENERAL. Even though they may, under certain circumstances, attract hazardous wildlife, the land use practices discussed in this section have flexibility regarding their location or operation and may even be under the airport operator's or sponsor's control. In general, the FAA does not consider the activities discussed below as hazardous to aviation if there is no apparent attraction to hazardous wildlife, or wildlife hazard mitigation techniques are implemented to deal effectively with any wildlife hazard that may arise.

3-2. ENCLOSED WASTE FACILITIES. Enclosed trash transfer stations or enclosed waste handling facilities that receive garbage indoors; process it via compaction, incineration, or similar manner; and remove all residue by enclosed vehicles, generally would be compatible, from a wildlife perspective, with safe airport operations, provided they are not located on airport property or within the runway protection zone (RPZ). No putrescible-waste should be handled or stored outside at any time, for any reason, or in a partially enclosed structure accessible to hazardous wildlife.

Partially enclosed operations that accept putrescible-waste are considered to be incompatible with safe airport operations. FAA recommends these operations occur outside the separations identified in the siting criteria in 1-3.

3-3. RECYCLING CENTERS. Recycling centers that accept previously sorted, non-food items such as glass, newspaper, cardboard, or aluminum are, in most cases, not attractive to hazardous wildlife.

3-4. COMPOSTING OPERATIONS ON AIRPORTS. FAA recommends against locating composting operations on airports. However, when they are located on an airport, composting operations should not be located closer than the greater of the following distances: 1,200 feet from any aircraft movement area, loading ramp, or aircraft parking space; or the distance called for by airport design requirements. This spacing is intended to prevent material, personnel, or equipment from penetrating any Obstacle Free Area (OFA), Obstacle Free Zone (OFZ), Threshold Siting Surface (TSS), or Clearway (see AC 150/5300-13, *Airport Design*). On-airport disposal of compost by-products is not recommended for the reasons stated in 2-3.d.

a. Composition of material handled. Components of the compost should never include any municipal solid waste. Non-food waste such as leaves, lawn clippings, branches, and twigs generally are not considered a wildlife attractant. Sewage sludge, wood-chips, and similar material are not municipal solid wastes and may be used as compost bulking agents.

b. Monitoring on-airport composting operations. If composting operations are to be located on airport property, FAA recommends that the airport operator monitor composting operations to ensure that steam or thermal rise does not affect air traffic in any way. Discarded leaf disposal bags or other debris must not be allowed to blow onto any active airport area. Also, the airport operator should reserve the right to stop any operation that creates unsafe, undesirable, or incompatible conditions at the airport.

3-5. ASH DISPOSAL. Fly ash from resource recovery facilities that are fired by municipal solid waste, coal, or wood, is generally considered not to be a wildlife attractant because it contains no putrescible matter. FAA generally does not consider landfills accepting only fly ash to be wildlife attractants, if those landfills: are maintained in an orderly manner; admit no putrescible-waste of any kind; and are not co-located with other disposal operations.

Since varying degrees of waste consumption are associated with general incineration, FAA classifies the ash from general incinerators as a regular waste disposal by-product and, therefore, a hazardous wildlife attractant.

3-6. CONSTRUCTION AND DEMOLITION (C&D) DEBRIS LANDFILLS. C&D debris (Class IV) landfills have visual and operational characteristics similar to putrescible-waste disposal sites. When co-located with putrescible-waste disposal operations, the probability of hazardous wildlife attraction to C&D landfills increases because of the similarities between these disposal activities.

FAA generally does not consider C&D landfills to be hazardous wildlife attractants, if those landfills: are maintained in an orderly manner; admit no putrescible-waste of any kind; and are not co-located with other disposal operations.

3-7. WATER DETENTION OR RETENTION PONDS. The movement of storm water away from runways, taxiways, and aprons is a normal function on most airports and is necessary for safe aircraft operations. Detention ponds hold storm water for short periods, while retention ponds hold water indefinitely. Both types of ponds control runoff, protect water quality, and can attract hazardous wildlife. Retention ponds are more attractive to hazardous wildlife than detention ponds because they provide a more reliable water source.

To facilitate hazardous wildlife control, FAA recommends using steep-sided, narrow, linearly-shaped, rip-rap lined, water detention basins rather than retention basins. When possible, these ponds should be placed away from aircraft movement areas to minimize aircraft-wildlife interactions. All vegetation in or around detention or retention basins that provide food or cover for hazardous wildlife should be eliminated.

If soil conditions and other requirements allow, FAA encourages the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

3-8. LANDSCAPING. Wildlife attraction to landscaping may vary by geographic location. FAA recommends that airport operators approach landscaping with caution and confine it to airport areas not associated with aircraft movements. All landscaping plans should be reviewed by a wildlife damage management biologist. Landscaped areas should be monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be implemented immediately.

3-9. GOLF COURSES. Golf courses may be beneficial to airports because they provide open space that can be used for noise mitigation or by aircraft during an emergency. On-airport golf courses may also be a concurrent use that provides income to the airport.

Because of operational and monetary benefits, golf courses are often deemed compatible land uses on or near airports. However, waterfowl (especially Canada geese) and some species of gulls are attracted to the large, grassy areas and open water found on most golf courses. Because waterfowl and gulls occur throughout the U.S., FAA recommends that airport operators exercise caution and consult with a wildlife damage management biologist when considering proposals for golf course construction or expansion on or near airports. Golf courses should be monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be implemented immediately.

3-10. AGRICULTURAL CROPS. As noted above, airport operators often promote revenue-generating activities to supplement an airport's financial viability. A common concurrent use is agricultural crop production. Such use may create potential hazards to aircraft by attracting wildlife. Any proposed on-airport agricultural operations should be reviewed by a wildlife damage management biologist. FAA generally does not object to agricultural crop production on airports when: wildlife hazards are not predicted; the guidelines for the airport areas specified in 3-10.a-f. are observed; and the agricultural operation is closely monitored by the airport operator or sponsor to ensure that hazardous wildlife are not attracted.

NOTE: If wildlife becomes a problem due to on-airport agricultural operations, FAA recommends undertaking the remedial actions described in 3-10.f.

a. Agricultural activities adjacent to runways. To ensure safe, efficient aircraft operations, FAA recommends that no agricultural activities be conducted in the Runway Safety Area (RSA), OFA, and the OFZ (see AC 150/5300-13).

b. Agricultural activities in areas requiring minimum object clearances. Restricting agricultural operations to areas outside the RSA, OFA, OFZ, and Runway Visibility Zone (RVZ) (see AC 150/5300-13) will normally provide the minimum object clearances required by FAA's airport design standards. FAA recommends that farming operations not be permitted within areas critical to the proper operation of localizers, glide slope indicators, or other visual or electronic navigational aids. Determinations of minimal areas that must be kept free of farming operations should be made on a case-by-case basis. If navigational aids are present, farm leases for on-airport agricultural activities should be coordinated with FAA's Airway Facilities Division, in accordance with FAA Order 6750.16, *Siting Criteria for Instrument Landing Systems.*

NOTE: Crop restriction lines conforming to the dimensions set forth in Table 2 will normally provide the minimum object clearance required by

FAA airport design standards. The presence of navigational aids may require expansion of the restricted area.

c. Agricultural activities within an airport's approach areas. The RSA, OFA, and OFZ all extend beyond the runway shoulder and into the approach area by varying distances. The OFA normally extends the farthest and is usually the controlling surface. However, for some runways, the TSS (see AC 150/5300-13, Appendix 2) may be more controlling than the OFA. The TSS may not be penetrated by any object. The minimum distances shown in Table 2 are intended to prevent penetration of the OFA, OFZ, or TSS by crops or farm machinery.

NOTE: Threshold Siting standards should not be confused with the approach areas described in Title 14, Code of Federal Regulations, Part 77, (14 CFR 77), *Objects Affecting Navigable Airspace.*

d. Agricultural activities between intersecting runways. FAA recommends that no agricultural activities be permitted within the RVZ. If the terrain is sufficiently below the runway elevation, some types of crops and equipment may be acceptable. Specific determinations of what is permissible in this area requires topographical data. For example, if the terrain within the RVZ is level with the runway ends, farm machinery or crops may interfere with a pilot's line-of-sight in the RVZ.

e. Agricultural activities in areas adjacent to taxiways and aprons. Farming activities should not be permitted within a taxiway's OFA. The outer portions of aprons are frequently used as a taxilane and farming operations should not be permitted within the OFA. Farming operations should not be permitted between runways and parallel taxiways.

f. Remedial actions for problematic agricultural activities. If a problem with hazardous wildlife develops, FAA recommends that a professional wildlife damage management biologist be contacted and an on-site inspection be conducted. The biologist should be requested to determine the source of the hazardous wildlife attraction and suggest remedial action. Regardless of the source of the attraction, prompt remedial actions to protect aviation safety are recommended. The remedial actions may range from choosing another crop or farming technique to complete termination of the agricultural operation.

Whenever on-airport agricultural operations are stopped due to wildlife hazards or annual harvest, FAA recommends plowing under all crop residue and harrowing the surface area smooth. This will reduce or eliminate the area's attractiveness to foraging wildlife. FAA recommends that this requirement be written into all on-airport farm use contracts and clearly understood by the lessee.

Table 2. Minimum Distances Between Certain Airport Features And Any On-Airport Agriculture Crops.

Aircraft Approach Category And Design Group [1]	Distance In Feet From Runway Centerline To Crop		Distance In Feet From Runway End To Crop		Distance In Feet From Centerline Of Taxiway To Crop	Distance In Feet From Edge Of Apron To Crop
	Visual & ≥ ¾ mile	< ¾ mile	Visual & ≥ ¾ mile	< ¾ mile		
Category A & B Aircraft						
Group I	200 [2]	400	300 [3]	600	45	40
Group II	250	400	400 [3]	600	66	58
Group III	400	400	600	800	93	81
Group IV	400	400	1,000	1,000	130	113
Category C, D & E Aircraft						
Group I	530 [3]	575 [3]	1,000	1,000	45	40
Group II	530 [3]	575 [3]	1,000	1,000	66	58
Group III	530 [3]	575 [3]	1,000	1,000	93	81
Group IV	530 [3]	575 [3]	1,000	1,000	130	113
Group V	530 [3]	575 [3]	1,000	1,000	160	138
Group VI	530 [3]	575 [3]	1,000	1,000	193	167

1. Design Groups are based on wing span, and Category depends on approach speed of the aircraft.

Group I: Wing span up to 49 ft.
Group II: Wing span 49ft. up to 78 ft.
Group III: Wing span 79 ft. up to 117 ft.
Group IV: Wing span 118 ft. up to 170 ft.
Group V: Wing span 171 ft. up to 213 ft.
Group VI: Wing span 214 ft. up to 261 ft.

Category A: Speed less than 91 knots
Category B: Speed 91 knots up to 120 knots
Category C: Speed 121 knots up to 140 knots
Category D: Speed 141 knots up to 165 knots
Category E: Speed 166 knots or more

2. If the runway will only serve small airplanes (12,500 lb. And under) in Design Group I, this dimension may be reduced to 125 feet; however, this dimension should be increased where necessary to accommodate visual navigational aids that may be installed. For example farming operations should not be allowed within 25 feet of a Precision Approach Path Indicator (PAPI) light box.

3. These dimensions reflect the TSS as defined in AC 150/5300-13, Appendix 2. The TSS cannot be penetrated by any object. Under these conditions, the TSS is more restrictive than the OFA, and the dimensions shown here are to prevent penetration of the TSS by crops and farm machinery.

SECTION 4. NOTIFICATION OF FAA ABOUT HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AN AIRPORT.

4-1. GENERAL. Airport operators, land developers, and owners should notify the FAA in writing of known or reasonably foreseeable land use practices on or near airports that either attract or may attract hazardous wildlife. This section discusses those notification procedures.

4-2. NOTIFICATION REQUIREMENTS FOR WASTE DISPOSAL SITE OPERATIONS. The Environmental Protection Agency (EPA) requires any operator proposing a new or expanded waste disposal operation within 5 statute miles of a runway end to notify the appropriate FAA Regional Airports Division Office and the airport operator of the proposal (40 CFR 258, *Criteria for Municipal Solid Waste Landfills*, section 258.10, *Airport Safety*). The EPA also requires owners or operators of new municipal solid waste landfill (MSWLF) units, or lateral expansions of existing MSWLF units that are located within 10,000 feet of any airport runway end used by turbojet aircraft or within 5,000 feet of any airport runway end used only by piston-type aircraft, to demonstrate successfully that such units are not hazards to aircraft.

a. **Timing of Notification.** When new or expanded MSWLFs are being proposed near airports, MSWLF operators should notify the airport operator and the FAA of this as early as possible pursuant to 40 CFR Part 258. Airport operators should encourage the MSWLF operators to provide notification as early as possible.

NOTE: AC 150/5000-3 provides information on these FAA offices.

b. **Putrescible-Waste Facilities.** In their effort to satisfy the EPA requirement, some putrescible-waste facility proponents may offer to undertake experimental measures to demonstrate that their proposed facility will not be a hazard to aircraft. To date, the ability to sustain a reduction in the numbers of hazardous wildlife to levels that existed before a putrescible-waste landfill began operating has not been successfully demonstrated. For this reason, demonstrations of experimental wildlife control measures should not be conducted in active aircraft operations areas.

c. **Other Waste Facilities.** To claim successfully that a waste handling facility sited within the separations identified in the siting criteria in 1-3 does not attract hazardous wildlife and does not threaten aviation, the developer must establish convincingly that the facility will not handle putrescible material other than that as outlined in 3-2. FAA requests that waste site developers provide a copy of an official permit request verifying that the facility will not handle putrescible material other than that as outlined in 3-2. FAA will use this information to determine if the facility will be a hazard to aviation.

4-3. NOTIFYING FAA ABOUT OTHER WILDLIFE ATTRACTANTS. While U. S. EPA regulations require landfill owners to provide notification, no similar regulations require notifying FAA about changes in other land use practices that can create hazardous wildlife attractants. Although it is not required by regulation, FAA requests those proposing land use changes such as those discussed in 2-3, 2-4, and 2-5 to provide similar notice to the FAA as early in the development process as possible. Airport operators that become aware of such proposed development in the vicinity of their airports should also notify the FAA. The notification process gives the FAA an opportunity to evaluate the effect of a particular land use change on aviation safety.

The land use operator or project proponent may use FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, or other suitable documents to notify the appropriate FAA Regional Airports Division Office.

It is helpful if the notification includes a 15-minute quadrangle map of the area identifying the location of the proposed activity. The land use operator or project proponent should also forward specific details of the proposed land use change or operational change or expansion. In the case of solid waste landfills, the information should include the type of waste to be handled, how the waste will be processed, and final disposal methods.

4-5. FAA REVIEW OF PROPOSED LAND USE CHANGES.

a. The FAA discourages the development of facilities discussed in section 2 that will be located within the 5,000/10,000-foot criteria in 1-3.

b. For projects which are located outside the 5,000/10,000-foot criteria, but within 5 statute miles of the airport's aircraft movement areas, loading ramps, or aircraft parking areas, FAA may review development plans, proposed land use changes, operational changes, or wetland mitigation plans to determine if such changes present potential wildlife hazards to aircraft operations. Sensitive airport areas will be identified as those that lie under or next to approach or departure airspace. This brief examination should be sufficient to determine if further investigation is warranted.

c. Where further study has been conducted by a wildlife damage management biologist to evaluate a site's compatibility with airport operations, the FAA will use the study results to make its determination.

d. FAA will discourage the development of any excepted sites (see Section 3) within the criteria specified in 1-3 if a study shows that the area supports hazardous wildlife species.

4-6. AIRPORT OPERATORS. Airport operators should be aware of proposed land use changes, or modification of existing land uses, that could create hazardous wildlife attractants within the separations identified in the siting criteria in 1-3. Particular attention should be given to proposed land uses involving creation or expansion of waste water treatment facilities, development of wetland mitigation sites, or development or expansion of dredge spoil containment areas.

a. AIP-funded airports. FAA recommends that operators of AIP-funded airports, to the extent practicable, oppose off-airport land use changes or practices (within the separations identified in the siting criteria in 1-3) that may attract hazardous wildlife. Failure to do so could place the airport operator or sponsor in noncompliance with applicable grant assurances. FAA recommends against the placement of airport development projects pertaining to aircraft movement in the vicinity of hazardous wildlife attractants. Airport operators, sponsors, and planners should identify wildlife attractants and any associated wildlife hazards during any planning process for new airport development projects.

b. Additional coordination. If, after the initial review by FAA, questions remain about the existence of a wildlife hazard near an airport, the airport operator or sponsor should consult a wildlife damage management biologist. Such questions may be triggered by a history of wildlife strikes at the airport or the proximity of the airport to a wildlife refuge, body of water, or similar feature known to attract wildlife.

c. Specialized assistance. If the services of a wildlife damage management biologist are required, FAA recommends that land use developers or the airport operator contact the appropriate state director of the United States Department of Agriculture/Animal Damage Control (USDA/ADC), or a consultant specializing in wildlife damage management. Telephone numbers for the respective USDA/ADC state offices may be obtained by contacting USDA/ADC's Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD, 20737-1234, Telephone (301) 734-7921, Fax (301) 734-5157. The ADC biologist or consultant should be requested to identify and quantify wildlife common to the area and evaluate the potential wildlife hazards.

d. Notifying airmen. If an existing land use practice creates a wildlife hazard, and the land use practice or wildlife hazard cannot be immediately eliminated, the airport operator should issue a Notice to Airmen (NOTAM) and encourage the land owner or manager to take steps to control the wildlife hazard and minimize further attraction.

APPENDIX 1. DEFINITIONS OF TERMS USED IN THIS ADVISORY CIRCULAR.

1. **GENERAL.** This appendix provides definitions of terms used throughout this AC.

a. Aircraft movement area. The runways, taxiways, and other areas of an airport which are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft exclusive of loading ramps and aircraft parking areas.

b. Airport operator. The operator (private or public) or sponsor of a public use airport.

c. Approach or departure airspace. The airspace, within 5 statute miles of an airport, through which aircraft move during landing or takeoff.

d. Concurrent use. Aeronautical property used for compatible non-aviation purposes while at the same time serving the primary purpose for which it was acquired; and the use is clearly beneficial to the airport. The concurrent use should generate revenue to be used for airport purposes (see Order 5190.6A, *Airport Compliance Requirements*, sect. 5h).

e. Fly ash. The fine, sand-like residue resulting from the complete incineration of an organic fuel source. Fly ash typically results from the combustion of coal or waste used to operate a power generating plant.

f. Hazardous wildlife. Wildlife species that are commonly associated with wildlife-aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a wildlife-aircraft strike hazard.

g. Piston-use airport. Any airport that would primarily serve FIXED-WING, piston-powered aircraft. Incidental use of the airport by turbine-powered, FIXED-WING aircraft would not affect this designation. However, such aircraft should not be based at the airport.

h. Public-use airport. Any publicly owned airport or a privately-owned airport used or intended to be used for public purposes.

i. Putrescible material. Rotting organic material.

j. Putrescible-waste disposal operation. Landfills, garbage dumps, underwater waste discharges, or similar facilities where activities include processing, burying, storing, or otherwise disposing of putrescible material, trash, and refuse.

k. Runway protection zone (RPZ). An area off the runway end to enhance the protection of people and property on the ground (see AC 150/5300-13). The dimensions of this zone vary with the design aircraft, type of operation, and visibility minimum.

l. Sewage sludge. The de-watered effluent resulting from secondary or tertiary treatment of municipal sewage and/or industrial wastes, including sewage sludge as referenced in U.S. EPA's *Effluent Guidelines and Standards*, 40 C.F.R. Part 401.

m. Shoulder. An area adjacent to the edge of paved runways, taxiways, or aprons providing a transition between the pavement and the adjacent surface, support for aircraft running off the pavement, enhanced drainage, and blast protection (see AC 150/5300-13).

n. Turbine-powered aircraft. Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft rotary-wing aircraft.

o. Turbine-use airport. Any airport that ROUTINELY serves FIXED-WING turbine-powered aircraft.

p. Wastewater treatment facility. Any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes, including Publicly Owned Treatment Works (POTW), as defined by Section 212 of the Federal Water Pollution Control Act (P.L. 92-500) as amended by the Clean Water Act of 1977 (P.L. 95-576) and the Water Quality Act of 1987 (P.L. 100-4). This definition includes any pretreatment involving the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. (See 40 C.F. R. Section 403.3 (o), (p), & (q)).

q. **Wildlife.** Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring there of (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this AC, WILDLIFE includes feral animals and domestic animals while out of the control of their owners (14 CFR 139.3, *Certification and Operations: Land Airports Serving CAB-Certificated Scheduled Air Carriers Operating Large Aircraft (Other Than Helicopters)*).

r. **Wildlife attractants.** Any human-made structure, land use practice, or human-made or natural geographic feature, that can attract or sustain hazardous wildlife within the landing or departure airspace, aircraft movement area, loading ramps, or aircraft parking areas of an airport. These attractants can include but are not limited to architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquacultural activities, surface mining, or wetlands.

s. **Wildlife hazard.** A potential for a damaging aircraft collision with wildlife on or near an airport (14 CFR 139.3).

2. **RESERVED.**