MAPPING AND INVENTORY OF RIPARIAN AREAS OF THE CAVE CREEK SYSTEM

PREPARED BY

THE DESERT FOOTHILLS LAND TRUST

FUNDED WITH A HERITAGE FUND GRANT FROM

THE ARIZONA GAME AND FISH DEPARTMENT

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DISCLAIMER

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The Carefree Town Council

Robert Anderson, Mayor	Robert March, Vice Mayor
John Curtiss	Hugh Stevens
David Dennison	Truman Stevens
Sharon Reese	Jonathan H. Pearson, Town Administrator

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A SPECIAL DEDICATION

The Desert Foothills Land Trust Board of Directors wishes to recognize the special contributions of Stephen Jones, local botanist and advisor to the Land Trust Board of Directors. Stephen is diligent in his pursuit of environmental education opportunities for the school children of the Desert Foothills region, and it is their work in conducting the inventories and analysis of the vegetative communities which has greatly aided the project and inspired other participants to bring it to completion.

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Ecology Club Members

Christine Baumgarthurber	Patricia Bello	Jessica Dixon
Lura Dulaney	Danielle Gange	Rachel Harris
Mary Hittner	Elisabeth Klasek	Katie Lawson
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Paula Dalton	Karen Anderson	Susan Beeler

Thank you for all your good work. This report is dedicated to you.

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I. INTRODUCTION

About the Land Trust...

Incorporated in 1990 as a private non-profit, charitable organization, the Desert Foothills Land Trust is dedicated to protect and preserve, through private initiative, natural open space resources of the upper Sonoran desert. The Trust is governed by a board of directors who work hard to understand the history, resources and potential of the desert foothills area.

Traditionally, land trusts employ a variety of protection and preservation tools in their natural resource conservation effort. Property may be acquired through outright gift, conservation easement, purchase or bequest. Various tax benefits may accrue to the property owner in each situation. The opportunity to become a part of the permanent legacy of natural lands and wildlife haven to be enjoyed by current and future generations is present for every potential donor.

Many land trusts are organized to counter a specific threat. Often a long-term land conservation strategy is lacking. With limited financial resources and few, if any professional employees, many trusts find it difficult to evaluate land resources and preservation options or to determine which lands to protect first. As the pace of development quickens, conservation opportunities are lost. Efforts become ad hoc, protecting the lands offered rather than key tracts more environmentally sensitive, historically significant or aesthetically pleasing. The need for a planned, prioritized approach to land protection becomes critically apparent.

In 1991 DFLT board members, recognizing this need, initiated a strategic planning process which would identify and set priorities for open space preservation. The planning process began by articulating the basic values of the Trust. Protection and preservation of riparian areas were among the highest priorities to come out of this meeting.

About riparian areas...

Riparian areas in the desert southwest are extremely sensitive habitats. They serve the essential life support functions for nearly seventy percent of the threatened and endangered species of the area and their disappearance would likely cause the demise of 100% of the wildlife who directly live in, and depend on them. The Trust recognizes that the Cave Creek System, if maintained with wide, open corridors and natural vegetation, can provide some of the most valuable wildlife habitat in the desert foothills region.

Natural drainage corridors provide numerous water quality benefits. Riparian vegetation stabilizes channel banks and provides a certain scrubbing action which helps to limit pollutant discharge.

All tributaries contribute to the recharge of local ground water supplies. Stable natural drainage channels, which support riparian vegetation, provide for contact and recharge opportunities between surface and ground water. Areas along the Cave Creek System and its tributaries are subject to frequent flooding and the integration of sound flood plain management techniques, such as preserving open wash corridors and protecting natural vegetation, is imperative to facilitate the recharge of groundwater supplies.

The Cave Creek System and its tributaries have served as conduit, not only for animals but also as trails for humans. The continued ability of these channels to serve this function is threatened by increased development through out the area. In many cases, access is denied both humans and/or animals by the construction of fences, barriers, or placement of signs. Property owners have this right. But it is

important to recognize the value of this attribute of our community to both humans and wildlife; to be able to travel along natural corridors.

About the mapping and inventory study...

The Cave Creek System and its natural tributaries are a vital link in a larger environmental system. Each stream is a vital natural and cultural resource. As the population of Maricopa County continues to expand, critical and sensitive wildlife areas will inevitably be lost, unless wildlife conservation and habitat preservation are integrated with urban growth and development through local planning processes.

This study, funded by a grant from the Arizona Game and Fish Heritage Fund provides an inventory of land covers in a format readily available to planners working to incorporate open space values, conservation measures and mitigation policies into their urban plans. The focus of the study is a comprehensive inventory of vegetative communities along the Cave Creek System. An automated geographic information system (GIS) and aerial photographs were used to construct a computerized vegetative model of the study area. The computerized model of vegetative communities was then compared to actual ground cover (field checked) to verify the data from the aerial photos.

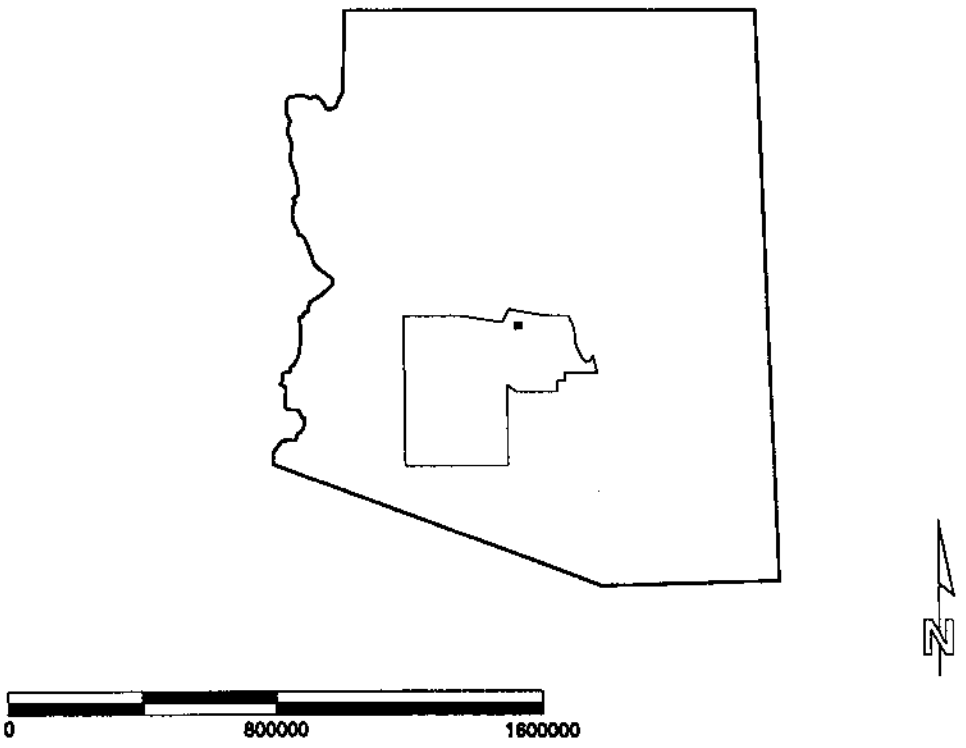
The computer study provides detailed data in GIS format on vegetative communities and wildlife habitat categories on three study sites. Future projects will build data, adding detail as additional sites are studied through the assistance of area land owners and residents. The data has three primary uses; aiding the Trust's decision process, aiding Arizona Game and Fish Department in its development of comprehensive regional vegetative inventories needed to draft standards for regional vegetative inventory and policy recommendations; and aiding municipal and county planners in long term planning to allow integration of wildlife habitat preservation with urban growth and development. The ultimate benefit of the project is to the people and wildlife of the area and to the legacy we leave in the land itself.

Organizations and individuals interested in accessing the GIS data assembled for this project may contact the Desert Foothills Land Trust at PO Box 4861, Cave Creek, AZ 85331, phone 602-488-6131.

II. STUDY AREA

GENERAL

The study area (Figure 1), located in northern Maricopa County, encompasses fifty-six square miles of upper Sonoran desert. It is bounded on the south by Carefree Highway, on the north and east by Tonto National Forest, and on the west it stretches approximately one mile beyond the western boundary of the Cave Creek Recreational Area. The study area also encompasses the corporate limits of two municipalities, the Towns of Carefree and Cave Creek, and a portion of the northern reaches of the City of Scottsdale.



Study Area
(in Northern Maricopa County)

Figure 1

The study area consists of Arizona Upland vegetation, a subdivision of Sonoran Desert scrub, as described by R. M. Turner and D. E. Brown (1982). Arizona Upland vegetation is found generally between 1500 and 3000 feet of elevation. Extremes are known at 1000 feet and 3900 feet. The vegetation type extends northward from northern Sonora through Tucson, and northwesterly along a belt through north Phoenix, ending in an area west of Prescott. The Arizona Upland receives more rain than most desert areas and is the least desert-like desert scrub vegetation type in North America.

The portions of Arizona Upland vegetation in the study area are dominated by triangle-leaf bursage, foothills palo verde, and several species of cacti. Turner and Brown's description of the Arizona Upland subdivision contains a further breakdown into three "series". The study area best fits their Palo Verde-Cacti-Mixed Scrub series.

While Arizona Upland is a widespread vegetation type, it is being regularly reduced by human impact. Road-building, home-building, and larger-scale developments are reducing the amount of Arizona Upland not only in the Cave Creek area but region wide. The most rapid rate of loss is occurring near urban areas. This trend shows no sign of abating in the future.

Four riparian vegetation types are found in the study area: cottonwood-willow forest, mesquite bosque, blue palo verde forest, and foothill palo verde forest. Cottonwood-willow forest is the most water-dependent type, and it is found only along the watercourse of Cave Creek where water is above ground year-round, or nearly year-round. Spring areas along the tributary washes, mostly in areas where impermeable layers of rock force water near the surface, also host small patches of cottonwood-willow forest.

Mesquite bosques are found in areas of sand and gravel deposition along the creek and in some tributaries. They are made up almost exclusively of velvet mesquite, but several shrubs are common. Vines take advantage of the branches of trees and are common in the bosques. Grasses commonly cover the ground in the bosques, though few of the grasses are native to America.

The palo verde forests are found in the tributary washes of Cave Creek. The blue palo verde forest accounts for the largest portion of riparian vegetation in the study area. It makes up most of the large tributary washes to the east of Cave Creek. It is a mixed community type, and as such it provides the most diverse habitat in the study area.

The foothills palo verde forest type is found in the small, secondary and finer tributary washes and is similar to the surrounding upland vegetation. The foothills palo verde is ubiquitous in the upland community as well, but several other species thrive in the riparian forest which help delineate it from the upland vegetation. The vegetation is much thicker and more dense along the small tributaries and is easily discernible in aerial photographs and in the field.

ARCHAEOLOGICAL SETTING

Due to the presence of water, Cave Creek was utilized by the Hohokam civilization. Most of the Hohokam sites along Cave Creek are of the Early Classic Period (1150-1300 AD), Soho Phase (Wood 1990). During the Soho Phase, the Hohokams were spreading out from the previous population centers along the Salt and Gila Rivers, due principally to a deteriorating resource base in the major valleys. Most of the occupation of the area was short-lived, due to the lack of suitable water and soil resources for agriculture and long-term occupation.

Limited occupation by small groups began in the late Pre-Classic Period (850-1150 AD). There is evidence of some canal agriculture and runoff-trapping practices along the southern portions of the study area, west of Black Mountain. During the late Early Classic Period, improvements in Hohokam water utilization technology made it possible to colonize the land north of the study area. Settlement of the study area appears to have ended by the 14th century, though larger permanent settlements of that period are known along upper Cave Creek and Camp Creek. One defensive encampment on Elephant Butte probably was constructed during this period. The entire Foothills area was abandoned by the late 14th century.

The effects of Hohokam land use practices are hard to measure, because so many changes have taken place since their occupation of the study area. Areas cleared for agriculture were obviously disturbed, but are now generally indistinguishable from the undisturbed background vegetation. The settlements, rock houses, petroglyphs and tools of the Hohokam are found all through the study area. They are as threatened by large-scale development of the area as the riparian vegetative communities.

HISTORICAL SETTING

After the Hohokam abandonment, the Yavapai and O'otam peoples used the area, mostly utilizing the game. The Yavapai were nomadic, and the O'otam settlements were along the Salt and Gila rivers, so no permanent settlements are known in the study area. Since Yavapai and O'otam relations were antagonistic, the area could have served as a buffer between them. This use had less impact on the vegetative communities than did the Hohokam occupation. No evidence or trace of the Spanish occupation of Arizona in the 16th and 17th centuries is known in the study area.

Arizona became a part of the United States in 1848 and was established as a territory in 1863, but not until after the Civil War did the United States make its presence known in the study area. With the establishment of Fort McDowell on the Verde River in 1865, U.S. soldiers frequently passed through the area. A hay cutting enterprise, established in what is now Phoenix, serviced the livestock at Fort McDowell and further increased the soldier's activity here.

In 1870 a road between Fort McDowell and Prescott was established. It followed Cave Creek from the Andorra Hills area (where a stage station was later established) north for about two miles, then went west. A road from Phoenix to Cave Creek was established in 1873, connecting Phoenix to Prescott along this route. In 1875 the Army built a new road to the south of the old one, along what is now New River Road. This road, which was preferred by heavy freight wagons, crossed Cave Creek, but did not follow it. The raiding habits of the Yavapais, mistaken for the Apache, from whom they had apparently learned to raid, led to their suppression by the U.S. Army.

Once they were suppressed, mining became a prime reason for occupation of the study area. Several mines were established between 1874 and the 1890's, and mining continues to a limited extent to this day. Several stamp mills were established during the period of heaviest mining activity. The stamp mills

were primarily steam-driven, and the mesquite bosques were clear-cut to feed them. All the bosques were cut out at one time or another (Carlson 1988). All mesquite growth in the bosques today are second-and-third-growth, or are newly-established on sand and gravel bars that have formed since then.

Some cattle ranching took place during the mining era. However, by the 1890's, sheep ranching was the predominant activity. Sheepmen found the Cave Creek area and Paradise Valley to the south to be favorable for wintering sheep. In 1898, a sheep shearing station, store and stage station was established at the Andorra Hills site of the old road.

The sheep station foundered in 1908. After this, cattle ranching became the predominant land use in the study area and its surroundings.

Unregulated grazing had severe consequences on the Cave Creek watershed, water relations, and the vegetative communities along Cave Creek. Excessive removal of vegetation led to stream bank erosion. Floods were larger and resulted in yet more erosion. Overgrazing on the Cave Creek watershed, due to the grazing industry's presence in the study area, led to the establishment of European plant species, primarily from the Mediterranean. In places these species are now major components of the vegetative communities.

GEOLOGIC SETTING

The deepest and largest elements of the study area are derived from two sources. The western half of the area is made up of Precambrian sand, silt and clay sediments deposited between 1.8 and 1.7 billion years ago (bya). The sediments were metamorphosed during the Mazatzal Orogeny, a tectonic event which occurred between 1.74 and 1.65 bya. The resulting rock is a metamorphic argyllite-phyllite complex (meta-argyllite-phyllite complex). It is characterized as a layered rock, aligned at various angles at its exposures.

The second large element was formed about 1.4 bya, when a large pluton of granitic material intruded into what is now the eastern half of the study area. The pluton further metamorphosed the meta-argyllite-phyllite complex and tilted the bedding to near the vertical. This happened at great depth, under material which has since been removed by erosion. The contact point between the pluton and the meta-argyllite-phyllite complex is exposed along a north-south line through the middle of Black Mountain.

The granite pluton cooled slowly, permitting the formation of large feldspar and quartz crystals, interlaced with mica and other smaller crystals and minerals. This granite is called the Camelback granite formation (Doorn and Pewé 1991). Where exposed, it appears as large granite boulder outcroppings. Between 1.65 bya and 22 mya (million years ago) erosion and exposure of the top of the pluton took place.

The next major event was a period of volcanism between 22 and 13 mya. The series of volcanic events are revealed at the surface in the mesas and mountains to the north. Initial volcanism consisted of tuffaceous (granitic) extrusion, also called ash flow. Basaltic extrusive material (lava flows) covered the tuff in later events. Some of the tuff was deposited in lacustrine (lake) environments before being covered by basaltic flows.

About 6 mya, a block-faulting event occurred along east-west fault lines, roughly between Black Mountain and the mesas and mountains to the north. The dropped block, topped with basalt from the volcanic period, formed a deep basin. The basin was then filled with material eroded from nearby areas, primarily with the large feldspar and quartz crystals (=granite grus) of the Camelback formation, to a

depth of over 2000 feet. This unconsolidated sediment is known as the Grapevine member of the Carefree formation. The material filling the washes of the eastern basin is granite grus.

Since then a general period of lifting of the whole area has raised the basin and surrounding mountains in relation to Paradise Valley to the south. Erosion of the Carefree formation is ongoing.

The Grapevine member of the Carefree formation, sitting in an impermeable basin, holds a groundwater pool up to 2000 feet deep. Since it is made up of loose granite grus, it is very permeable and yields water easily. Dense meta-argyllite-phyllite and sediments just to the east of Cave Creek form a "dam" at the lower end of the basin and cut the basin off from Cave Creek itself.

Along Cave Creek are a series of terraces formed by the deposition of material flowing down from the mountains to the north along the alignment of Cave Creek. Four levels of terrace are present, representing four separate periods of creek deposition. Vestiges of all four terraces are present on the western side of Cave Creek, but only the lower three appear on the eastern side of the creek. Only the lower terrace, the Hidden View terrace, contains significant riparian vegetation. It supports a very large area of the *Cercidium floridum* Association (224.523) on the west side of Cave Creek.

III. METHODOLOGY

INTRODUCTION TO BIOTIC COMMUNITY STUDIES IN ARIZONA

Much of the early work done to establish the principles of biogeography took place in the southwestern United States. The list of biologists and ecologists who worked here includes C. Hart Merriam, E. W. Nelson, E. A. Goldman, Joseph Grinnell, Homer Shantz, Forrest Shreve, and F. E. Clements. The remarkable variety of biotic communities made the southwest an ideal location for study. The elevational relief of the southwest made study easier, since many biotic communities could be found within one mountain range, and several very different biomes could be visited in one day.

MERRIAM: The earliest work in determining and defining biotic communities in Arizona was done around the turn of the century by Clinton Hart Merriam. By studying changes in vegetation and fauna with changes in elevation, he divided Arizona into generalized "life-zones". He split the Sonoran desert into the Lower and Upper Sonoran life-zones. The study area falls into his description of the Upper Sonoran life-zone.

SHREVE: The first published work covering the study area, as an element of a much larger study area, was Forrest Shreve's Vegetation of the Sonoran Desert, published by the Carnegie Institute in 1951. Shreve delineated the Sonoran desert and divided it into seven major vegetation types. He did not carry his study to the point of defining riparian areas as separate vegetation communities, but made mention of them as sub-communities within broader communities.

Shreve first coined the term Arizona Upland used today to describe the broad community in which the study area lies. This community consists of the northeastern, higher-elevation portion of the Sonoran desert, from Magdalena and Altar in Sonora, Mexico, to the U.S.-Mexican border, roughly between Sonoita and Sasabe, northward to between Ajo and Tucson, and covering the lower portions of the Santa Cruz, San Pedro and Salt Rivers, including the area around Roosevelt Lake, thence westward along a belt through north Phoenix, through Wickenburg, and west to the upper reaches of the Bill Williams River.

SHELFORD: V. E. Shelford (1945), using faunal as well as floral components, defined communities as "biomes", naming each biome after its principal floral and faunal members, e.g., the creosote bush-kit fox biome, and the shadscale-kangaroo rat biome. These roughly correspond to Merriam's lower and upper Sonoran life-zones.

LOWE: Charles H. Lowe (1961) extended this concept further by introducing a hierarchical system of ecological classification similar to systems of taxonomic classification of plant and animal species. He produced a four tiered system of classification:

Formation-class
Formation
Association-type
Association

Lowe (1964) applied this work to the state of Arizona in Part 1 of The Vertebrates of Arizona. He did not classify riparian areas separately, instead explaining them as fingers extending downward from higher-altitude communities.

RECENT STUDIES

In the 1970's, Lowe and David E. Brown, of the Arizona Game and Fish Department, embarked on work to expand the hierarchical system. In 1979 they published (along with C. P. Pase of the US Forest Service) "a digitized classification system for the biotic communities of North America, with community (series) and association examples for the southwest". They outlined a digitized system which covers the entire world. After dividing the world into seven "biogeographic realms", based on the six continents plus the oceanic realm, they created a seven-level hierarchy which covered North America.

The eight levels they defined are:

Biogeographic (Continental) Realm
Vegetation ["First Level"]
Formation-type
Climatic (Thermal) Zone
Regional Formation (Biome)
Series (Community of generic dominants)
Association (Community of specific dominants)
Composition-structure-phase

Following this work, Brown edited a collection of descriptions of biotic communities of southwestern north America. "Biotic communities of the American southwest--US and Mexico" (1982) describes the biotic communities of the southwest down to the regional formation, or biome, level. Each biome is characterized by the presence of indicator plant and animal species. No methodology was given for determining vegetation type beyond the presence of certain species.

Though riparian biomes are digitized in this work as wetland vegetation, the descriptions of riparian biomes in the text do not strictly follow the digitized system.

RIPARIAN STUDIES

Several recent works have focused on classification and utilization of riparian vegetation types, but none have applied the Brown, Lowe and Pase system. Reichhart et al. (1978) inventoried and mapped vegetation types on the San Pedro River in southern Arizona, utilizing aerial photography combined with field work. Ecological work quantifying wildlife utilization of specific vegetation types was done along the lower Colorado River (Anderson et al., 1977). Johnson and Carothers (1982) studied the interrelationships and impacts of recreational uses on riparian vegetation types.

Robert Szaro (1989) of the US Forest Service published a system of classification of riparian community types which did not follow Brown, Lowe and Pase, but which did give a specific methodology of determining community type by assessing measurements of total tree density, total shrub density and total basal area. Community type can be determined by following a key based on those measurements. In his studies on national forests in Arizona and New Mexico, he described twenty riparian forest types and eight riparian scrub types.

ONGOING WORK

TONTO NATIONAL FOREST: On the Tonto National Forest, Lew Myers of the USFS has developed the Tonto Riparian Inventory and Monitoring Method (TRIMM) to comply with the Forest Service's Riparian Aquatic Survey and Evaluation System (RACES). TRIMM is used to quantify streams and riparian communities, assessing vegetation, stream sinuosity, stream profile and soil analysis. Vegetation is assessed using the point-centered quarter method, a plotless method of measuring vegetation. A method of assessing herbivore utilization is also included.

ARIZONA GAME AND FISH DEPARTMENT: The Arizona Game and Fish department is under mandate from the state legislature to complete an inventory of Arizona riparian communities. They are using the Colorado Plateau Vegetation Advisory Committee's delineation manual for assessing riparian communities. Game and Fish is assessing mile-long sections of stream and classifying each section based on tree and shrub inventory, stream classification, soil classification and hydrology. Aerial videography is one tool being used to assess vegetation.

Game and Fish is using Brown, Lowe and Pase as a basis for vegetation classification and is modifying and expanding the system as work progresses.

THE CAVE CREEK STUDY

The study of the riparian areas of the Cave Creek system was conceived as an effort to provide a basic understanding of the location, extent, current condition, and existing and potential value of riparian areas in the Desert Foothills. It was determined that, in order to provide a foundation on which to locate and map riparian areas, it would first be necessary to develop several mapped basic data layers, including the assessor's parcels, soils, drainage ways and flood plains. In order to be consistent with data development in the various state and federal agencies engaged in riparian studies, it was decided to develop the basic data for this study using the "PC ARC/INFO" Geographic Information System. This will permit easy access to the data developed as a part of this study and serve as a beginning for the development of a comprehensive digital data base of natural resource information in the Desert Foothills region.

The Brown, Lowe and Pase digitized system was selected as most appropriate for this study. The digitization is helpful in the geographic information system (GIS) mapping portion of the project and is appropriate for the method of assessment of community types. Communities were identified by presence of dominant species, which is easy to determine without detailed ecological measurements. The community edges are relatively easy to determine by simple observation, both in the field and using aerial photographs.

Mapping of vegetation communities of Cave Creek and the tributary washes to the east utilized aerial photographs provided by the Towns of Cave Creek and Carefree. Community boundaries were identified using the aerial photographs, with field checking to determine the species composition and thus the biotic community. The surrounding upland vegetation was determined by identifying the vegetation type to Brown, Lowe and Pase's Series level (fifth level). Riparian vegetation was identified to the Association level (sixth level).

Arizona Game and Fish provided an unpublished revision of Brown, Lowe and Pase's digitized system, prepared by Bennett, Johnson, Kunzmann and Lowe (Draft 3.4), which was used in this study. Relevant portions of the revision are listed in Appendix A.

More intensive study was made on three portions of Cave Creek to further define the associations and to quantify plant species present in each community. Some determination of subassociations was also assessed in the intensive study areas. The species found in these study areas are listed in Appendix B, along with their relative abundance in the five plant communities found.

INVOLVEMENT OF LOCAL SCHOOLS

An important element of this study was education, and local schools were solicited for their cooperation. Dr. David Alexander, superintendent of the Cave Creek School District, encouraged the involvement of students and instructors. Paula Dalton and Karen Alexander, science instructors at the district's Desert Arroyo Middle School, volunteered their time and encouraged students to join in the study.

The goal was to work a trade: help from the students in assessing the Creek (both objectively and subjectively), in exchange for providing the students some experience in biological field work. A similar program in the Portland-Vancouver area, the Green City Data Project, served as a model. Most of the students from Desert Arroyo Middle School were members of the school's ecology club, but several non-member students also participated.

Following a classroom introduction to the study and its methodology, four field trips were scheduled--one per month through the spring 1993 semester. Field trips were arranged to three study sites: the Desert Foothills Land Trust's Watt Preserve, Cahava Ranch, and Spur Cross Ranch. The Watt Preserve was surveyed twice at different seasons, late winter and mid-spring. The focus was on riparian biotic communities, but, at the Watt Preserve, the Arizona Upland subdivision was included.

At each site the students were given a general tour of the site, and each of the biotic communities was described and defined. Following the tour the students were divided into groups, each assigned to a different biotic community. An effort was made to expose each student to a different community on each field trip.

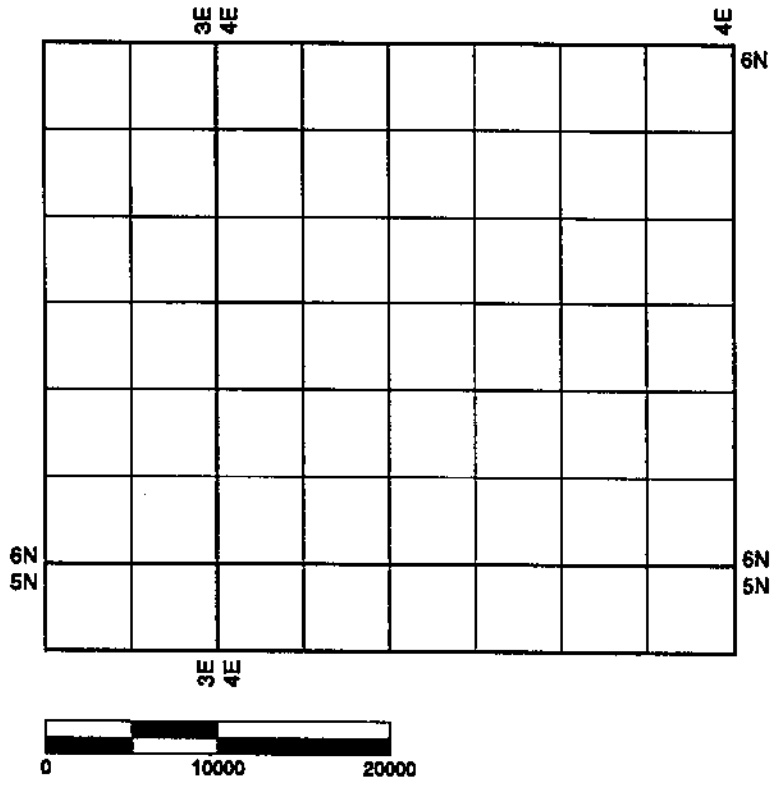
Using a seven-page evaluation form adapted from the Green City Project, and species checklists, the groups catalogued plant, bird, and mammal species present in each community. (See Appendix D for a copy of the data collection form.) Plant checklists were divided into separate lists for tree, shrub, and herbaceous species. Birds were checked off as noted, and the method of identification was given--whether the species was seen, heard, or its nest was found, or any combination. Mammals were also listed, and methods of identification were noted. Identifications were by sight, sound, or the presence of tracks, holes or nests, or any combination.

Subjective assessments of the study site's condition were noted as well. Neighboring land uses, sights, sounds, smells, and evidence of current, historical and archeological land uses were noted. Vegetation cover was rated by subjective measurement. Cover type was listed, and visual estimates of percentage of tree, shrub and herbaceous cover was noted. A checklist of stream characteristics was also completed by each group of students. Each group completed a stream checklist for the portion of the stream moving through the entire site, irrespective of the biotic community to which they were assigned.

Once the field work was completed, each group of students summarized its findings in short reports, which were returned, along with their original field data collection forms, to the study authors. Copies were also provided to the owners of the study sites. (See Appendix E for a sample of the student's assessments of a field trip to Spur Cross Ranch.)

Control Grid

It is important in the development of a Geographic Information System to establish a horizontal control early in the process. The Town of Cave Creek had, in 1989, contracted an engineering firm to conduct a "Road Study" for the town. As one of the products in this study, the engineers made an aerial photo flight of the town using ground control points of fifty quarter section corners. These quarter section corners were surveyed, marked on the ground and used as control during the extraction of several layers of physical features from the aerial imagery. The coordinates of these control points were compiled into a digital map to be used as the basis of an area-wide ground control system for further digital map base preparation. From this control base a grid was created, representing the bounds of the sections which make up the entire study area of the Cave Creek System Riparian Study. The purpose of the grid is to serve as the base for the preparation of an atlas of the map products prepared for this study.



Control Grid
(Comprised of 56 Sections)
Figure 2

Parcel Map

The quarter section parcel maps maintained by the Maricopa County Assessor's Office were used as the data source for this map layer. The Land Trust had previously acquired the parcel coverage for the area that is within the corporate limits of the Town of Cave Creek and AutoCad DXF files covering the area within the corporate limits of the Town of Carefree. The AutoCad DXF files were converted to Arc/Info covers and appended to the coverage for the Town of Cave Creek. The current Assessor's parcel maps were used to update each change in the parcel line changes in the Towns of Cave Creek and Carefree.

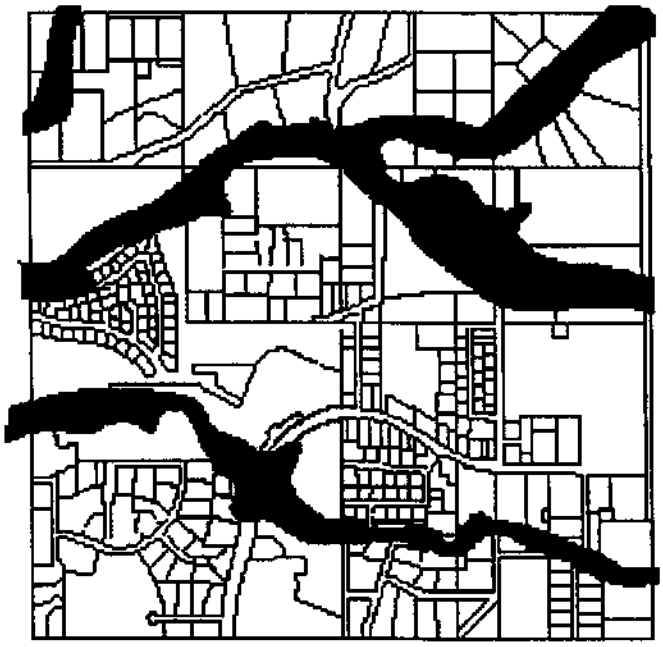
The Assessor's parcel maps were used to digitize the remainder of the study area. The next step involved the addition of the parcel number to each of the parcels in the study area. This was to serve as the identifier for further data input to include the ownership information, land use, etc. The result was parcel coverage for the entire study area, updated to December 1992, and including parcel number identifiers. This information will allow the Land Trust to determine ownership of parcels with significant riparian areas. The zoning and land use of these parcels can also be mapped to assess potential threats to riparian areas, and this information can be provided to land use decision makers in the jurisdictions. The respective jurisdictions can use this information to inform the development community of valuable resources on and near their projects and work to limit potential harmful impacts.

Parcel Map
Township 6 North - Range 4 East Section 28

Figure 3

Flood Plain Map

Riparian areas in the desert southwest are often associated with the flood plains of perennial and intermittent streams, such as Cave Creek and its tributaries. Riparian areas serve a critical flood control function in such areas and, as such, should be valued and protected. The cost of replicating their flood control functions should serve as a disincentive to the filling of and building upon flood plains. The Flood Insurance Rate Maps covering the study area were obtained from the Maricopa County Flood Control District, and the Zone A (100 year) flood plains of Cave Creek and its tributaries were digitized as another map layer.

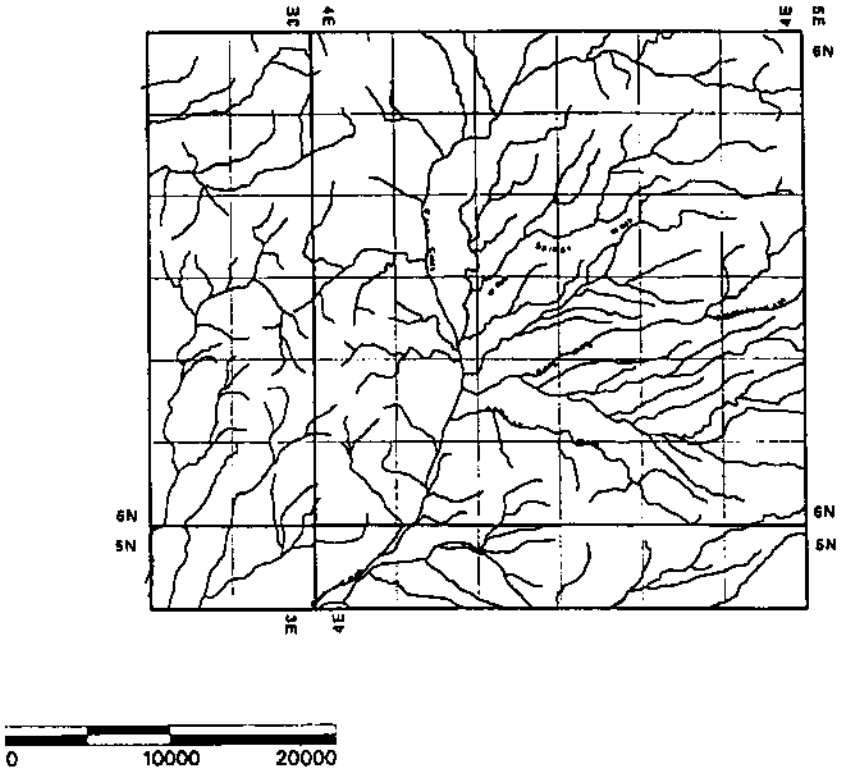


Flood Plains
(100 year)

Figure 4

Hydrology Map

The Town of Cave Creek, as part of its "Road Study" digitized the centerlines of all drainageways within the study area using aerial imagery produced through a sophisticated photogrammetry process. The product was an AutoCad DXF file containing the drainage lines. This file was converted into an ARC/Info cover, and necessary editing was done to connect the various lengths. The drainage centerlines, as found on U.S.G.S. topographic maps were used to complete the drainage coverage for the entire study area. An attribute was added to the cover to distinguish drainage lines from the aerial imagery and those digitized from the U.S.G.S. quadrants.



Hydrology
(Cave Creek and its Tributaries)

Figure 5

IV. INVENTORY ASSOCIATIONS AND STUDY AREA SITES

The study area includes one series (BL&P level 5) of upland vegetation and four riparian associations (BL&P level 6). the background vegetation is the Palo Verde-Mixed Cacti ("Arizona Upland") series (154.12). Several associations within the series were noted during the field work, but not mapped. Riparian vegetation consists of four associations within two series. three associations are members of the leguminous short tree series (224.52): the *Prosopis velutina* Association (224.521), the *Cercidium floridum* Association (224.523) and the *Cercidium microphyllum* Association (224.524). one association from the cottonwood-willow series (224.53) is present; the *Populus fremontii-Salix gooddingii* Association (224.531).

Besides the background vegetation and the riparian associations, one other mapped but unclassified "community" consists of open, sandy, often braided main channels of the washes. These areas could have been included within the surrounding communities, but sometimes formed borders between two different communities. Defining them as separate biotic communities is difficult, as periodic flooding makes them ephemeral. For the mapping portion of the project, they were given the letter designation of "OS," for open sand.

Riparian habitat loss has been substantial in the state of Arizona. Some estimates run as high as a loss of 95-99% of the pre-European riparian habitat. Comeaux (1981) states that "most of the small streams in the state flowed year-round at the time of the European contact... today, most of the small streams are intermittent, flowing only after rainy periods." Reasons for the loss include livestock grazing, regulation and damming of streams and lowering water tables. (Szaro 1989).

INVENTORY ASSOCIATIONS

Prosopis velutina Association (224.521)

The *Prosopis velutina* Association covers large sections of the creek. It is found in areas of relatively deep sand and gravel deposition. Velvet mesquite (*Prosopis velutina* Woot.) is the dominant species and is usually the only tree species present. In older, well established communities, it can form a nearly solid canopy up to 30 feet high. The association is commonly called a mesquite *bosque* (Spanish for "wood").

Mesquite is adapted to areas of sand and gravel deposition because of its ability to grow a long tap root into the water table. This gives it a competitive advantage over other tree species in areas of deposition.

Bosques are not commonly flooded, but are inundated in the highest flood episodes. The presence of thick vegetation–grasses, shrubs, as well as mesquite trees–slows the water flow, which causes it to drop its sediment load.

Trees such as velvet ash, sycamore and net-leaf hackberry can sometimes be found in bosques.

There are many species of shrub within the association. Some of them are more common in the surrounding upland community (creosote bush, catclaw acacia, chollas, tomatillos) or washes (desert broom, canyon bursage), while others are almost exclusive to bosques (greythorn, desert hackberry). Several species of vine also occur in bosques, taking advantage of the trees and shrubs for support. Clematis and climbing milkweed are common and can also be found, to a lesser degree, in washes. Wild cucumber is almost exclusive to mesquite bosques.

Some bosques host the hemiparasitic shrub desert mistletoe. This plant also occurs in the upland community in leguminous (=bean family) trees and shrubs such as palo verdes, catclaw acacia, and ironwood. Stunted specimens can be found on creosote bushes.

Some mesquite bosques have no desert mistletoe, while others have plants in nearly every tree. The seeds of desert mistletoe are spread by birds, prominently the phainopepla, whose adults utilize the fruit during the winter and spring months.

Winter grasses and other ephemeral plant species very commonly cover the ground in bosques. They thrive on the relatively high nitrate content of the soil in bosques, which is derived from two sources: flood depositions and the detritus from mesquite leaf drop. Sediment deposited during high floods is rich in detritus, which releases nitrates and other nutrients as it decomposes. Leaf drop adds nitrates since mesquite, like many other leguminous species, is a nitrogen-fixing plant. Mesquite is a deciduous species and drops its leaves in the fall and early winter. Depending on temperature, they may drop some or all of their leaves. In extreme cold they will drop all of their leaves.

The grasses that thrive in the mesquite bosques of the study area are red brome, wild barley, ripgut grass and downy chess. Mediterranean grass is found in more open areas. These are all non-native introductions from Europe. The perennial bermuda grass, also non-native, is found in bosques, but is more common near open water.

Some of the non-native herbaceous species present in the bosques within the study area include horehound, London rocket, filaree and cheeseweed.

These introduced species have completely replaced such native grasses such as vine-mesquite grass, and the herbaceous careless-weed. The native species still present include canaigre, isocoma and aster.

All the bosques along Cave Creek were completely clear-cut by early European immigrants, mostly by miners cutting wood for the steam-driven stamp mills (Carlson 1988). Some of the bosques have recovered by regrowth from stumps, some from seed in areas of new deposition, and some not at all–in areas where the deposition was stripped away by flooding after the cover was removed. Remaining bosques can be differentiated between old and new by the condition of the trees present. Where the mesquites regrew from stumps, the stumps can sometimes be seen. Where new depositions took place, the trees are small and sometimes dense, having come from seed rather than stumps.

Cercidium floridum Association (224.523)

The largest riparian vegetation association in the study area is a well-mixed community found mainly in large areas of the tributary washes. Its principal component species come from the *Prosopis velutina* Association (224.521) and the Palo Verde-Mixed Cacti Series (154.12). Using the Bennett, et al., designations, the mixed community best fits the *Cercidium floridum* Association (224.523). Taking it to the subassociation level, it easily fits within the *Cercidium floridum-Prosopis velutina* Subassociation (224.5231).

The community is found in the washes, between the stream strands of open sand and gravel, and is growing on stabilized sand and gravel deposits. The vegetation is fairly stable, in spite of being present in flood-prone areas. Trees can reach a great age, and patches can remain undisturbed for long periods of time. Species normally found in the Arizona Upland community can become well-established. Triangle-leaf bursage, chollas, Mormon tea, saguaro, creosote bush and foothills palo verde are common examples. Mesquite bosque species are common as well. Mesquite, hackberry, tomatillo, greythorn and wild cucumber are common in the more stable areas. Disturbed-land species such as desert broom, canyon bursage, and catclaw acacia are common, but tend to be more common along the edges of the open strands, where the soil is more likely to have been recently disturbed.

The *Cercidium floridum* Association is the most diverse element in the broader Arizona Upland system. As such, it likely supports a broader range of animal life, especially where above-ground water can be found nearby.

Another definable set of plant communities is found on the slopes along the creek and associated washes. The larger and steeper slopes contain their own guilds of species. Due to the patchiness of slope communities, and the lack of separate designations at the association level, these were not delineated from the *Cercidium floridum* Association.

Species composition of the slopes is quite dependent on the position of the slope relative to the sun. Drier south-and west-facing slopes tend to reflect the species composition of the Arizona Upland community, with the addition of some disturbed-land species such as canyon bursage and catclaw acacia. Plants such as brittlebush, viguera and desert mallow appear more often along slopes than in the surrounding upland community.

North-and east-facing slopes, however, contain some species from the surrounding Arizona Upland Association, plus a few shrubs and herbaceous species from the Interior Chaparral Regional Formation (133.1), along with a few species that are almost exclusive to slopes.

Some large shrubs from the Arizona Upland community thrive on the north-and east-facing slopes. Jojoba and crucifixion thorn often cover large areas on the north-facing slopes. Foothills palo verde is common on east-facing slopes, and frequently occurs on south-facing and west-facing slopes.

Interior chaparral plants common to north-facing and east-facing slopes include Wright buckwheat, oreganillo, bricklebush, and ragged rock flower. Bricklebush and ragged rock flower are almost completely restricted to wash slopes, but can occasionally be found on higher slopes in the chaparral community.

Cercidium microphyllum Association (224.524)

This association is found in the smaller trace washes feeding the major washes and can be differentiated from the Arizona Upland community and the *C. floridum* Association (224.523). It is marked by an increased presence of foothills palo verde (*C. microphyllum* (Torr.) Rose and Johnst.). Since its species composition is dependent on the concentration of water, and defined by the presence of disturbed-land species such as canyon bursage, desert broom and catclaw acacia, it is a riparian community.

As in the *C. floridum* Association, water provides the disturbance which increases the presence of disturbed-land plants. Sheet flooding in large storms and in winter rains is directed into these initial channels.

Species from the Arizona Upland community can often occur in this association in larger size, larger numbers and/or healthier condition due to the increase in water availability. Wildflowers and grasses sometimes proliferate here. Some of the Arizona Upland species which are more frequently found in this community include, besides the above, Parish viguera, Trixis californica, odora and San Felipe dyssodia.

Populus fremontii - Salix gooddingii Association (224.531)

The rarest riparian community type within the study area is the cottonwood-willow association *(Populus fremontii - Salix gooddingii* Association). It is only found where water is permanently available at or near

the surface. Cottonwoods and willows are obligate phreatophytes, meaning that they are dependent on surface water.

Cottonwood and willow are related species, both being in the willow family, Salicaceae. They reproduce by seed, prodigious quantities of which are produced on the female trees each spring. Both species are dioecious, meaning that an individual plant is either male or female. The females of both have very small seeds with tufts of fine hairs attached, which allows seed distribution by both wind and water. The seeds tend to collect in low areas, in gravel, and at the edge of water flows. Large numbers of seeds sprout in these areas, particularly at water's edge, where the water supply is abundant. Large, clear areas can be thickly covered in young trees in a short period of time. However, few young trees survive to reach adulthood. Grazing, periodic drying and flooding all take their toll on young trees.

As obligate phreatophytes, they are the most threatened by long-term trends in water and watershed management. Human-induced disturbances of surface water flow have severely reduced the area covered with this vegetation type. The disturbances include grazing, consequent flooding, regulation and damming of streams, water diversion and groundwater withdrawal.

Another trait shared by cottonwoods and willows is the ability of cuttings to take root. Restoration efforts by the Forest Service, other agencies and private landowners using cuttings directly planted in moist soil at stream edges have been very successful.

This ability to form roots along stem tissue is illustrated also where young willow plants have been pushed over and partially buried in floods. The tree roots all along the former trunk, and forms a thicket of new willow stems. This habit is also shared by the introduced tamarisk.

In the study area, one large and several small portions of this community type exist along Cave Creek, and in small pockets in some of the tributary washes, where water is found at the surface, usually at bedrock exposures. One to several plants can grow in such locations.

It is difficult to measure how the cottonwood-willow communities along Cave Creek were affected by clearcutting of the late 19th and early 20th century. Current and future groundwater withdrawals may reduce the acreage further, as has been demonstrated in the San Pedro Basin (Reichhardt et al., 1978)

The construction of the Eagle Creek Golf Course severely disturbed the lower end of the largest cottonwood-willow community in the study area, and left a small (approximately ten acre) community downstream cut off from the larger community.

The use of water from a 200 acre-foot surface water allocation by the golf course owners will also have a impact on water availability to the disjunct community, and may also impact the large community upstream.

Velvet ash and sycamore are occasionally found in the cottonwood-willow community, with velvet ash being the more common of the two within the study area. Mesquite may also occur, but are rare. The invasive non-native tamarisk is also present, mainly along the edges and in the streambed, where it primarily competes with Goodding's willow.

Shrubs found in the community include seepwillow, desert broom, and southern cattail.

As in the mesquite bosques, the non-native red brome, wild barley, and bermuda grass are common grasses. They are less vigorous than they are in the mesquite bosques. An escape from cultivation, fountain grass, can also be found. The annual herb cocklebur is common in several locations along the creek as well.

INVENTORY SITES WITHIN THE STUDY AREA

Cahava Ranch

The site is generally within E1/2 NE1/4 NW1/4 and W1/2 NW1/4 NE1/4, Sec 20 T6N R4E, G&SRB&M. The area consists of the modern floodplain along the creek, and ends at the lower edges of the high terraces to the east and west. It runs 0.25 mile generally south-southeast along the creek, and is less than 0.125 mile wide at its widest. Elevation is approximately 2100 feet above sea level.

On outlying areas, above the terraces to the east and west, the vegetation type is Palo Verde-Mixed Cacti ("Arizona Upland") Series (154.12) as described by Turner and Brown (1982).

There are two types of riparian vegetation associations within the study area. The first is the Prosopis velutina Association (224.521) on the low sandy terrace in the eastern portion of the floodplain.

The other vegetation type consists of phreatophytic (=highly water-dependent) trees such as Fremont cottonwood, Goodding willow, velvet ash and Arizona sycamore, in the Populus fremontii - Salix gooddingii Association (224.531) This association occurs in and near the creekbed itself, the portion of the floodplain where the water regularly flows above ground.

The Cave Creek riverbed runs through the study area from northwest to southeast, for a linear length of about 1320 feet. At the time of the survey, water was flowing above ground through the entire length.

The presence of a number of Fremont cottonwood and Goodding willow trees, and other obligate phreatophyte species, indicate that the water table is close enough to the surface in the study area to support riparian vegetation types throughout the year.

Lowering of the water table, through large scale pumping operations which occur with developments such as golf courses, could have a negative impact on the phreatophytic vegetation. It is of special concern if withdrawals occur near to or upstream from the study area.

Watt Preserve

The site is a twenty-acre rectangular plot generally running along Cave Creek, 1320 feet on the north-south axis, by 660 feet east-west. It is contiguous with W1/2 SW1/4 SE1/4 Sec 29 T6N R4E, G&SRB&M as found on the USGS' Cave Creek quadrangle map of 1965 (revised 1981). Elevation is approximately 2000 feet above sea level. The western border meets with a quarter-section plot of state land which has been proposed for inclusion in the Cave Creek Recreation Area. The recreation area is managed by the Maricopa County Parks Department. To the north, along the route of Cave Creek, is the Eagle Creek Golf Course. Land to the east and south is privately-owned. Three distinct vegetation types were noted. One is a desertscrub vegetation type, and the other two are riparian types. The riparian types are associated with the presence of a surface water source or a shallow groundwater table.

The desertscrub vegetation type is Palo Verde-Mixed Scrub (Arizona Upland) Series. A small strip of vegetation along a steep east-facing bluff at the western limit of Cave Creek contained species commonly restricted to east- and north-facing slopes within the Arizona Upland Series. The riparian types consist of *Prosopis velutina* Association (224.521) and the *Populus fremontii-Salix gooddingii* Association (224.531).

The Cave Creek riverbed runs through the study area from northeast to southwest, for a linear length of over 1320 feet. At the time of the survey, water was flowing above ground through the entire length. It is not known how regularly water is found above ground.

The presence of a number of Fremont cottonwood and Goodding willow trees, and other water-dependent species, indicate that the water table is close enough to the surface at this point to support a riparian vegetation type through dry periods.

Continued lowering of the water table, as happened during the large-scale withdrawal of groundwater for the construction and early operation of the Eagle Creek Golf Course, could have a negative impact on the riparian portion of the study area. However, since the golf course has reduced, if not eliminated, reliance on groundwater by replacing it with Central Arizona Project water, the threat is now reduced.

Upstream, an area to the north of the adjoining golf course supports a dense Fremont cottonwood/Goodding willow forest. Construction of the golf course severely disrupted the continuity of the forest through to the study area.

Downstream, only a few cottonwood trees were noted, indicating a lower water table to the south. The lack of large trees indicates that the vegetation type below the study area changes.

The creekbed vegetation is a mix of the large trees, Fremont cottonwood and Goodding willow, along with smaller perennials such as seepwillow, burro brush and salt cedar. Salt cedar was introduced to America as an erosion control measure, and has invaded many riparian habitats throughout the southwestern U.S. The other species mentioned are all native to Arizona.

Mesquite bosques are often found on a sandy terrace near the main bed of a stream. Such is the case here. This community lies on a sandy terrace on the eastern bank of Cave Creek. Over 90% of the trees or shrubs within this community are mesquite. Other shrubs include greythorn, wolfberry, blue palo verde, and desert broom.

A significant portion of the trees in this community are young. Whether it is a new community due to recent deposition of the sandy terrace, woodcutting which has since been halted, fire, or other means, is unknown.

There is evidence of earth movement by machine on the terrace, and evidence of past trash dumping.

Spur Cross Ranch

Spur Cross Ranch is an approximately 2500 acre property south of the Tonto National Forest along Cave Creek. It is presently within the unincorporated area of Maricopa County. It contains significant sections of riparian communities along the creek. Cottonwood-willow forest lines much of the creekbed, and large mesquite bosque and blue palo verde communities can be found on the creek. There are also many significant archaeological sites on the property.

Due to the geology of the site, the water table is high enough in the area to support the large forests, and to maintain water above ground for enough of the year to support the obligate phreatophytes, especially at the southern end of the property.

A geologic blockage at the southern end of the property causes the creek to turn to the west, and has also allowed for the buildup of a large area of sand and gravel. A large mesquite bosque fills the basin thus formed on both sides of the creek.

Some disturbance is noted in the area. One large area of mesquite bosque was cleared for agriculture, and has been used in recent years as a tree nursery. Recent floods scoured the creekbed in places, removing some small sections of more unusual riparian vegetation types, such as cattail (*Typha domingensis*

Association, 244.711). These were noted in previous trips to the site, but had disappeared after the spring floods of 1993.

The upland vegetation consist of the same community type as that of the study sites to the south--Arizona Upland Series (154.12). There are some small areas on the property, principally on the north faces of hills and mountains, which exhibit species more common in the Scrub Oak Series(133.31) of the Interior Chaparral Biome (133.3).

V. WILDLIFE VALUES OF INVENTORY AREA

The relative value to wildlife of the four riparian associations identified in the inventory area are described in this section. These four associations are: the *Populus fremontii* (224.531), *Prosopis velutina* (224.521), *Cercidium floridum* (224.523), and *Cercidium microphyllum* (224.524).

The value to wildlife of each of the four riparian associations identified in the study area are listed in Table 1 below. These values were taken from tables presented in an Arizona Riparian Habitat Evaluation Model with Wildlife Values developed by Anderson and Ohmart (1993).

The Anderson and Ohmart (1993) Arizona Riparian Habitat Evaluation Model (ARHEM) was developed with look-up tables listing wildlife values for Arizona riparian habitats. The objective of the ARHEM was to provide a list of wildlife values that could be assigned to any of Arizona's riparian habitats that had been mapped.

The ARHEM model defined wildlife as birds and small and medium mammals. The assigned wildlife values were based on statistical analysis of five features that the author recognized as important to wildlife. These features were: vegetation type (based on Brown and Lowe 1973), vegetation structural type (defined in Anderson and Ohmart 1993), altitude and a latitude and longitude block.

Table 1: Wildlife values assigned by Anderson and Ohmart (1993) for the four riparian associations in the study area. The values theoretically range from -3 to 3, with 3 being the best habitat and -3 being the poorest. Values that exceed 3 indicate extremely high wildlife values.

Riparian Association		Wildlife Values*		
		B,M	B	M
224.531 *Populus fremontii-Salix gooddingii*	Cottonwood willow forest	3.2	2.1	1.0
224.521 *Prosopis velutina*	Mesquite bosque	1.5	.8	.7
224.523 *Cercidium floridum*	Blue palo verde forest	1.5	.8	.7
224.524 *Cercidium microphyllum*	Foothills palo verde forest	1.3	.6	.7

* B, M = birds and small mammals, coyotes and deer
B = birds
M = small mammals, coyotes and deer

The highest wildlife values (Table 1) of the four riparian associations in the study area were assigned to the cottonwood-willow forest association. This was consistent with the findings of Anderson and Ohmart (1994). The authors found that cottonwood and willow trees in high densities rank highest in wildlife value relative to other tree species in Arizona. This finding was based on the author's summary of a seven year data set for riparian habitats along 275 miles of the lower Colorado River.

The mesquite bosque and blue palo verde forest associations were tied in their wildlife values and were both less valuable to wildlife than the cottonwood willow association. The foothills palo verde forest association, with the lowest foliage height diversity, was of lower value to wildlife than the other three associations, but very close to the same value as the mesquite bosque and blue palo verde associations. This was also consistent with the findings of Anderson and Ohmart (1994) that vegetative communities with less foliage height diversity (fewer vertical layers of understory, midstory and canopy) were less functional to wildlife in Arizona. The wildlife value trends were true for both birds and mammals, and for only birds and only mammals.

It is also logical biologically that the vegetative communities closest to Cave Creek would be of greater wildlife value because the permanent water source, as well as the tree species and foliage height diversity, would attract more wildlife than a similar community without a permanent water source.

The blue palo verde forest riparian association contains a one acre man-made pond, which also increases wildlife diversity in the vegetative communities around the perimeter of the pond.

Although the values in Table 1 predicted by the ARHEM are consistent with other research, they need to be interpreted with caution. Possible weaknesses in the development of the ARHEM model need to be considered. These weaknesses were stated by the authors of the model:

1. The experimental design of the original study was not collected with the intention of developing a state-wide predictive wildlife model.

2. The model may not accurately predict wildlife values of patch sizes less then twenty-five acres. Most of the riparian associations mapped within the study area in this project were less than twenty-five acres.

3. Mammalian wildlife values come primarily from small mammals, coyotes, and deer.

4. The model does not predict wildlife values for amphibians, reptiles, and fishes.

5. The model does not predict wildlife values for species of special concern of federally listed species.

Also, the model has not been field tested in the study area of this project; therefore the accuracy of its predictive values are not known.

The wildlife value data in Table 1 is not representative of all of the land within the four riparian associations. Only one vegetative structural type, as categorized by Anderson and Ohmart (1993), was selected for each of the four riparian associations in the study area to calculate the wildlife values. The one vegetative structural type selected was an average that would occur in each association. The average structural types were selected after following the recommendations of Stephen Jones, botanist for the Desert Foothills Land Trust. It is highly likely that more than one structural type occurs in each of the riparian associations. The data necessary for determining the structural types was not collected in the field.

Also, the ARHEM model provides values for the wildlife community as a whole. It did not assign value of vegetative communities to individual species. A wildlife value for an individual species may differ from the overall wildlife value.

Although each of the riparian associations may be of different relative value to wildlife, each has overall importance to wildlife and to the ecosystem of the Sonoran desert. Each of the associations supports many wildlife species.

A list of wildlife species that potentially use each of the four riparian associations appears in Appendix C. These species listed are not necessarily totally dependent on riparian areas for their survival. They are species that are likely to occur in the study area.

These lists are based on a summary of wildlife species occurring in riaprian areas in Arizona compiled by Ohmart and Zisner (1993), and a list of the mammals in Arizona (Hoffmeister 1986). The lists were slightly modified by the author based on casual observations of wildlife during numerous visits to the

study area and through conversations with herpetologist Dr. Robert Bowker (Glendale Community College Biology teacher), and bat biologist Debbie Noel (Arizona Game and Fish Department).

This list in Appendix C is not based on standardized field inventories conducted in the study areas. Wildlife field inventories were not a part of this study; therefore species abundance, composition and actual occurrence in each of the four riparian associations is not yet known. This information will be important for future sound management of the riparian areas identified and is a crucial area for future study.

The list in Appendix C includes 110 species of birds, nineteen species of mammals, and twenty species of amphibians and reptiles that potentially use one or all of the riparian associations identified in the study area. Some of the species may be dependent on the riparian areas for breeding and others may not.

The functions of riparian habitat to wildlife are many. They provide areas for breeding and rearing young, water, forage, escape cover and travel corridors through unfavorable habitat.

Riparian areas have been called the "lifeblood" of the desert. Approximately 60 to 75 percent of Arizona's resident wildlife species are dependent on riparian habitats to sustain their populations, yet these riparian areas occupy less than 0.5 percent of the state's total land area (Arizona Riparian Council 1994).

In the last 100 years, a very large percentage of Arizona's low elevation riparian habitats have been altered or destroyed. Many of the plant and wildlife species that occur in riparian areas are threatened because of a loss of these habitats.

RECOMMENDATIONS

1. Standardized wildlife surveys should be conducted within the study area to obtain quantifiable values to wildlife communities of each of the riparian and upland vegetation associations mapped in the project. The quantifiable values could include estimates of species richness, animal densities, species diversities, and number of species of special concern.

2. The value of the study area's riparian habitats to wildlife, with special emphasis on the cottonwood-willow riparian association, needs to be considered by land use planners concerned with the future of the study area. As much as possible of the extremely valuable cottonwood-willow habitat along Cave Creek needs to be preserved. Some of each of the riparian habitats should be preserved to provide maximum wildlife diversity. Also, certain washes not interrupted by development should be designated for preservation to provide essential travel corridors for wildlife.

3. The pond in the blue palo verde forest riparian association should be maintained, to provide a second permanent water source in addition to Cave Creek. The pond attracts wildlife to its perimeter that may otherwise not have occurred in this association.

APPENDIX A

VEGETATIVE COMMUNITY CLASSIFICATIONS

Appendix A: Vegetative Community Classifications

An amplification of the Brown, Lowe and Pase system has been prepared by Bennett, Johnson, Kunzmann and Lowe. The following are classifications for communities relevant to the study. They come from Version 3.4 draft revision (undated), obtained from the Arizona Game and Fish Department.

Except for the Leguminous Short Tree Series (224.52), which Brown, Lowe and Pase call the Mesquite Series, all hierarchies from realm to series are the same as Brown, Lowe and Pase (1979). Some of the associations are different. Also, there are a number of subassociations listed in this document–none are present in Brown, Lowe and Pase. Some of the subassociations are not expected in the study area, but are listed for comparison. Notes are in brackets.

154 Tropical-Subtropical Desertlands
154.1 Sonoran Desertscrub
154.12 Palo Verde-Mixed Cacti ("Arizona Upland") Series
154.121 *Ambrosia deltoidea-Cercidium microphyllum*-mixed scrub Association
154.1211 *Ambrosia deltoidea-Cercidium microphyllum-Cereus giganteus*-mixed scrub Subassociation [*C. giganteus=Carnegiea gigantea*]
154.1212 *Ambrosia deltoidea-Cercidium microphyllum-Cereus giganteus-Encelia farinosa*-mixed scrub Subassociation
154.1213 *Cercidium microphyllum-Ambrosia deltoidea-Simmondsia chinensis* Subassociation [First two should be reversed here. *A. deltoidea* most prevalent, and consistent with other subassociations]
154.1214 *Ambrosia deltoidea-Cercidium microphyllum-Olneya tesota* Subassociation
154.122 *Ambrosia deltoidea-Carnegiea gigantea*-mixed scrub Association [Left out of this draft, but present in BL&P (1979).]
154.123 *Simmondsia chinensis*-mixed scrub Association
154.1231 *Simmondsia chinensis-Encelia farinosa-Fouquieria splendens* Subassociation
154.1232 *Simmondsia chinensis-Viguiera deltoidea-Fouquieria splendens* Subassociation
154.1233 *Simmondsia chinensis-Celtis pallida-Acacia greggii* Subassociation
154.1234 *Simmondsia chinensis-Atriplex polycarpa* Subassociation
154.124 *Larrea divaricata-Canotia holacantha* Association
154.125 *Larrea divaricata*-mixed scrub Association
154.126 *Encelia farinosa*-mixed scrub Association
154.1261 *Cercidium microphyllum-Encelia farinosa-Cereus thurberi-Jatropha cuneata* Subassociation [*C. thurberi=Stenocereus thurberi*]
154.1262 *Cercidium microphyllum-Encelia farinosa-Fouquieria splendens* Subassociation
154.1263 *Cercidium microphyllum-Encelia farinosa-Ambrosia dumosa* Subassociation
154.127 *Cercidium microphyllum-Cereus thurberi* Association
154.1271 *Cercidium microphyllum-Encelia farinosa-Cereus thurberi* Subassociation
154.1272 *Cercidium microphyllum-Ambrosia deltoidea-Cereus thurberi-Jatropha* spp. Subassociation
224 Tropical-Subtropical Swamp, Riparian and Oasis Forests
224.5 Sonoran Riparian and Oasis Forests
224.52 Leguminous Short Tree Series
224.521 *Prosopis velutina* Association
224.5211 *Prosopis velutina* Subassociation
224.5212 *Prosopis velutina-Isocoma acradenia* Subassociation
224.5213 *Prosopis velutina-Lycium* sp. [*exsertum*]-*Ziziphus obtusifolia* Subassociation

224.522 *Olneya tesota* Association
224.5221 *Olneya tesota-Ambrosia ambrosioides-Acacia greggii* Subassociation
224.523 *Cercidium floridum* Association
224.5231 *Cercidium floridum-Prosopis velutina* Subassociation
224.5232 *Cercidium floridum-Olneya tesota* Subassociation
224.5233 *Cercidium floridum-Prosopis glandulosa-Ambrosia ambrosioides* Subassociation
224.5234 *Cercidium floridum-Olneya tesota-Dalea spinosa* Subassociation
224.524 *Cercidium microphyllum* Association
224.5241 *Cercidium microphyllum-Ambrosia deltoidea-Olneya tesota* Subassociation

Alternately:
224.523 *Prosopis velutina*-mixed deciduous tree (*Populus, Sambucus, Celtis, Fraxinus)* Association
224.524 *Prosopis velutina-Populus fremontii* Association

224.53 Cottonwood-Willow Series
224.531 *Populus fremontii-Salix gooddingii* Association
224.532 *Populus fremontii* Association
224.533 *Salix gooddingii* Association
224.534 *Populus fremontii-Prosopis velutina* Association
234.712 *Prosopis velutina*-mixed scrub Association
234.7121 *Prosopis velutina-Opuntia* sp[p].-mixed cacti Subassociation [sp.=singular, spp.=plural]
234.7122 *Prosopis velutina-Suaeda torreyana* Subassociation
234.7123 *Prosopis velutina-Isocoma acradenia* Subassociation
234.7124 *Prosopis velutina-Ambrosia ambrosioides-Ambrosia cordifolia-Celtis pallida* Subassociation
234.721 *Tamarix chinensis* Association
234.722 *Tamarix chinensis*-mixed scrub Association
234.731 *Larrea divaricata-Ambrosia deltoidea* Association
234.732 *Hymenoclea monogyra* Association
234.733 *Hymenoclea salsola* Association
234.734 *Baccharis sarothroides* Association
234.7341 *Baccharis sarothroides-Cercidium microphyllum-Prosopis juliflora* Subassociation
234.735 *Simmondsia chinensis-Celtis pallida* Association
234.7351 *Simmondsia chinensis-Celtis pallida-Acacia greggii* Subassociation
244.711 *Typha domingensis* Association
244.7111 *Typha domingensis-Scirpus olneyi* Subassociation
254.711 *Baccharis glutinosa-Solanum nodiflorum-Nicotiana* spp.*-Rumex hymenosepalus* et al. Association

APPENDIX B

STUDY AREA SPECIES:
VEGETATIVE COMMUNITIES

Appendix B: List of species found in the study area. Only species that are found in riparian communities are listed, but relative abundance in the upland community is included. All scientific and most common names from Lehr (1978) and supplements (1980, 1982).

I	154.12 Palo Verde-Mixed Cacti ("Arizona Upland")	Series Arizona Upland	A	Abundant	
II	224.521 *Prosopis velutina* Association	Mesquite bosque	C	Common	
III	224.523 *Cercidium floridum* Association	Blue palo verde forest	O	Occasional	
IV	224.524 *Cercidium microphyllum* Association	Foothills palo verde forest	U	Uncommon	
V	224.531 *Populus fremontii-Salix gooddingii* Association	Cottonwood-willow forest	R	Rare	

Species	Family	Common Name	I	II	III	IV	V
Anisacanthus thurberi (Torr.) Gray	Acanthaceae	Desert Honeysuckle			R	R	
Amaranthus graecizans L.	Amaranthaceae	Prostrate Pigweed			R	O	
Sarcostemma cynanchiodes Decne.	Asclepiadaceae	Climbing Milkweed		O	O	O	
Sarcostemma hirtellum (Gray) Holm.	Asclepiadaceae	Rambling Milkweed		O	O	O	
Amsinckia intermedia Fisch. & Meyer	Boraginaceae	Coast Fiddleneck	O	O	C	C	
Cryptantha barbigera (Gray) Greene	Boraginaceae	Bearded Cryptantha	O	O	O	O	
Pectocarya heterocarpa Johnst.	Boraginaceae	Hairy-leaved Comb Bur	C	C	O	O	
Pectocarya platycarpa Munz & Johnst.	Boraginaceae	Broad-nutted Comb Bur	C	C	O	O	
Pectocarya recurvata Johnst.	Boraginaceae	Arch-nutted Comb Bur	C	C	O	O	
Carnegiea gigantea (Engelm.) Britt. & Rose	Cactaceae	Saguaro Cactus	C	R	U	O	
Ferocactus wislizenii (Engelm.) B. & R.	Cactaceae	Barrel Cactus	C	R	U	O	
Mammillaria microcarpa Engelm.	Cactaceae	Fishhook Cactus	O			O	
Opuntia acanthocarpa Engelm. & Bigel. var. *major*	------	-----					
Engelm. & Bigel.) Benson	Cactaceae	Buckhorn Cholla	C	U	O	C	
Opuntia bigelovii Engelm.	Cactaceae	Teddy Bear Cholla	O	R	U	U	
Opuntia fulgida Engelm.	Cactaceae	Jumping Cholla (Chain Fruit)	O	R	U	U	
Opuntia leptocaulis DC.	Cactaceae	Desert Christmas Cactus	O	R	O	O	
Opuntia phaeacantha Engelm. var. *discata* (Griffiths) Bens. & Walk.	Cactaceae	Engelmann's Prickly Pear	O	U	O	O	
Herniaria cinerea DC.	Caryophyllaceae	Burstwort	O	U	O	O	
Sagina decumbens (Ell.) T.& G. ssp. *occidentalis* (Wats.) Gray	Caryophyllaceae	Pearlwort	O	U	O	O	
Salsola iberica Sennen & Pau	Chenopodiaceae	Russian Thistle, Tumbleweed			U	U	
Ambrosia ambrosioides (Cav.) Payne	Compositae	Canyon Bursage	U	O	C	C	
Ambrosia confertifolia DC.	Compositae	Slimleaf Bursage	O	O	C	C	
Ambrosia deltoidea (Torr.) Payne	Compositae	Triangle-leaf Bursage	A	O	C	A	
Aster riparius HBK	Compositae	Aster		O	O	U	O
Baccharis salicifolia (R. & P.) Pers.	Compositae	Seepwillow		O	U		O
Baccharis sarothroides Gray	Compositae	Desert Broom	U	O	C	O	
Baileya multiradiata Harv. & Gray	Compositae	Desert Marigold	C	O	C	O	
Centaurea melitensis L.	Compositae	Tocolote		U	O		

I	154.12 Palo Verde-Mixed Cacti ("Arizona Upland")	Series Arizona Upland	A	Abundant
II	224.521 *Prosopis velutina* Association	Mesquite bosque	C	Common
III	224.523 *Cercidium floridum* Association	Blue palo verde forest	O	Occasional
IV	224.524 *Cercidium microphyllum* Association	Foothills palo verde forest	U	Uncommon
V	224.531 *Populus fremontii-Salix gooddingii* Association	Cottonwood-willow forest	R	Rare

Species	Family	Common Name	I	II	III	IV	V
Cirsium neomexicanum Gray	Compositae	Thistle		O	O		
Encelia farinosa Gray	Compositae	Brittlebush	O	U	O	O	
Ericameria laricifolia (Gray) Shinners	Compositae	Turpentine bush	O	O	C	O	
Erigeron lobatus A. Nels.	Compositae	Fleabane	U	C	O	U	
Hymenoclea monogyra T. & G.	Compositae	Burro Brush	U	U	O	U	
Hymenoclea salsola Torr. & Gray var. *pentalepis* (Rydb.) Benson	Compositae	Cheesebush		U	C	U	
Isocoma acradenia (Greene) Greene	Compositae	Isocoma			O	U	
Machaeranthera pinnatifida (Hook.)	------	--------					
Shinners ssp. *gooddingii* (A. Nels.) Turn. & Hartm.	Compositae	Machaeranthera	O		O	O	
Matricaria matricarioides (Less.) Porter	Compositae	Pineapple Weed			U	O	
Porophyllum gracile Benth.	Compositae	Odora	C		U	O	
Psilostrophe cooperi (Gray) Greene	Compositae	Paperflower	O		U	O	
Stephanomeria pauciflora (Torr.) A. Nels.	Compositae	Wire Lettuce	C		U	C	
Stylocline gnaphalioides Nutt.	Compositae	Everlasting Nest Straw	O	O	O	C	
Stylocline micropoides Gray	Compositae	Desert Nest Straw	O	O	O	C	
Trixis californica Kellogg	Compositae	Trixis	O	U	U	O	
Verbesina encelioides (Cav.) Benth. & Hook.	Compositae	Yellowtop, Cowpen Daisy		R	U	R	
Viguiera deltoidea Gray var. *parishii* (Greene) Vasey & Rose	Compositae	Parish Viguiera	O		U	O	
Xanthium strumarium L.	Compositae	Spiny Cocklebur		U	U		O
Tillaea erecta Hook. & Arn.	Crassulaceae	Pigmy Weed	U	O		U	
Crossosoma bigelovii Wats. var. *bigelovii*	Crossosomataceae	Ragged Rock Flower			U		
Draba cuneifolia Nutt. var. *integrifolia* Wats.	Cruciferae	Whitlow Grass	U	U	U	O	
Lepidium lasiocarpum Nutt. var. *lasiocarpum*	Cruciferae	Sand Peppergrass	O	U	O	O	
Lesquerella gordoni (Gray) Wats.	Cruciferae	Bladder Pod	U		U	U	
Nasturtium officinale R. Br.	Cruciferae	Water-cress					O
Sisymbrium irio L.	Cruciferae	London Rocket	O	C	O	O	O
Cucurbita digitata Gray	Cucurbitaceae	Finger-leaf Gourd	U	O	O	U	
Marah gilensis Greene	Cucurbitaceae	Big Root, Wild Cucumber	O	C	O		
Scirpus americanus Pers.	Cyperaceae	Bulrush, Tule					O
Ephedra fasciculata A. Nels.	Ephedraceae	Joint-fir, Mormon Tea	O	O	O	O	
Euphorbia arizonica Englem.	Euphorbiaceae	Spurge	O	C	O	O	O
Euphorbia melanadenia Torr.	Euphorbiaceae	Spurge	U	C	O	U	U
Euphorbia polycarpa Benth.	Euphorbiaceae	Small-seeded Sand Mat	O	C	O	O	

I	154.12 Palo Verde-Mixed Cacti ("Arizona Upland")	Series Arizona Upland	A	Abundant
II	224.521 *Prosopis velutina* Association	Mesquite bosque	C	Common
III	224.523 *Cercidium floridum* Association	Blue palo verde forest	O	Occasional
IV	224.524 *Cercidium microphyllum* Association	Foothills palo verde forest	U	Uncommon
V	224.531 *Populus fremontii-Salix gooddingii* Association	Cottonwood-willow forest	R	Rare

Species	Family	Common Name	I	II	III	IV	V
Fouquieria splendens Engelm.	Fouquieriaceae	Ocotillo	O	U	U	O	
Erodium cicutarium (L.) L'Her	Geraniaceae	Filaree	C	C	C	C	O
Erodium texanum Gray	Geraniaceae	Stork's Bill	U	U	U	U	
Aristida purpurea Nutt. var. *glauca* (Nees.) A.& N. Holmgren	Gramineae	Purple Three-awn	O		O	O	
Aristida purpurea Nutt. var. *purpurea*	Gramineae	Purple Three-awn	O	U	O	O	
Avena fatua L.	Gramineae	Wild Oat		C	U	U	O
Bromus rigidus Roth.	Gramineae	Ripgut Grass		C	U	U	O
Bromus rubens L.	Gramineae	Red Brome	A		A	A	O
Bromus tectorum L.	Gramineae	Downy Chess	O	A	O	O	
Erioneuron pulchellum (HBK) Tateoka	Gramineae	Fluff Grass	O	O	O	O	
Hordeum leporinum Link	Gramineae	Wild Barley	U		C	U	O
Poa bigelovii Vasey	Gramineae	Bigelow's Bluegrass	U	A	O	C	
Schismus barbatus (L.) Thell.	Gramineae	Mediterranean Grass	C	O	C		O
Emmenanthe penduliflora Benth.	Hydrophyllaceae	Whispering Bells	U	C			
Phacelia cryptantha Greene var. *cryptantha*	Hydrophyllaceae	Small-flowered Phacelia	O		O	O	
Krameria grayi Rose & Painter	Krameriaceae	White Ratany	O	U	O	O	
Hyptis emoryi Torr.	Labiatae	Desert Lavendar	R	O	U	U	
Lamium amplexicaule L.	Labiatae	Henbit		R	O	O	O
Marrubium vulgare L.	Labiatae	Horehound		O	O	O	
Salvia columbariae Benth.	Labiatae	Chia	O	C	O	U	
Acacia greggii Gray var. *arizonica* Isely	Leguminosae	Catclaw	O	O	C	C	
Calliandra eriophylla Benth.	Leguminosae	Fairy Duster	O	O	U	U	
Cercidium floridum Benth.	Leguminosae	Blue Palo Verde	O	O	C	U	
Cercidium microphyllum (Torr.) Rose & Johnst.	Leguminosae	Foothill Palo Verde	A	O	O	A	
Lotus humistratus Greene	Leguminosae	Hill Locust	O	U	O	O	
Lotus strigosus (Nutt.) Greene var. *tomentellus* (Greene) Isely	Leguminosae	Hairy Lotus	O	O	O	O	
Lupinus concinnus Agardh.	Leguminosae	Elegant Lupine		O	O	O	
Lupinus sparsiflorus Benth. ssp. *mohavensis* Dziekanowski & Dunn	Leguminosae	Lupine		U	O	O	
Melilotus officinalis (L.) Lam.	Leguminosae	Yellow Sweet Clover	U	U	O		C
Olneya tesota Gray	Leguminosae	Desert Ironwood	O	C	O	O	
Prosopis velutina Woot.	Leguminosae	Velvet Mesquite	O	U	C	O	
Senna covesii (Gray) Irwin & Barneby	Leguminosae	Desert Senna	O		O	O	
Dichelostemma pulchellum (Salisb.) Heller	Liliaceae	Bluedicks	O	C	U	O	

I	154.12	Palo Verde-Mixed Cacti ("Arizona Upland")	Series Arizona Upland	A	Abundant
II	224.521	*Prosopis velutina* Association	Mesquite bosque	C	Common
III	224.523	*Cercidium floridum* Association	Blue palo verde forest	O	Occasional
IV	224.524	*Cercidium microphyllum* Association	Foothills palo verde forest	U	Uncommon
V	224.531	*Populus fremontii-Salix gooddingii* Association	Cottonwood-willow forest	R	Rare

Species	Family	Common Name	I	II	III	IV	V
Sphaeralcea ambigua Gray var. *ambigua*	Malvaceae	Desert Mallow	U	O	C	C	
Boerhaavia intermedia Jones	Nyctaginaceae	Red Spiderling	O	O	O	U	
Mirabilis bigelovii Gray	Nyctaginaceae	Wishbone Bush		O	O	O	
Fraxinus pennsylvanica Marsh. ssp. *velutina* (Torr.) Rose & Johnst.	Oleaceae	Velvet Ash	O	U			O
Menodora scabra Gray	Oleaceae	Twinberry	C		U	O	
Plantago insularis Eastw.	Plantaginaceae	Woolly Plantain	C	O	O	C	
Plantago patagonica Jacq. var. *gnaphalioides* (Nutt.) Gray	Plantaginaceae	Plantain		O	O	C	
Platanus wrightii Wats.	Platanaceae	Arizona Sycamore	O	U			O
Eriastrum diffusum (Gray) Mason ssp. *diffusum*	Polemoniaceae	Eriaster	O	U	O	O	
Eriastrum diffusum (Gray) Mason ssp. *jonesii* Mason	Polemoniaceae	Jones Eriaster	O	U	O	O	
Eriogonum fasciculatum Benth. var. *polifolium* (Benth.) T. & G.	Polygonaceae	Wild Buckwheat	O	U	C	O	
Eriogonum wrightii Torr.	Polygonaceae	Wright Buckwheat			U	O	
Rumex hymenosepalus Torr.	Polygonaceae	Canaigre		C	C		O
Clematis drummondii Torr. & Gray	Ranunculaceae	Texas Virgin Bower	O	C	O		
Ziziphus obtusifolia (Hook.) A. Gray var. *canescens*	-----	-------					
(A. Gray) M. C. Johnston	Rhamnaceae	Greythorn		C	C	O	
Populus fremontii Wats. ssp. *fremontii*	Salicaceae	Fremont Cottonwood					C
Mimulus guttatus DC.	Scrophulariaceae	Monkey Flower					C
Simmondsia chinensis (Link) Schneid.	Simmondsiaceae	Jojoba	O	O	O	O	
Datura discolor Bernh.	Solanaceae	Desert Thorn Apple			O	U	
Lycium berlandieri Dunal var. *parviflorum* (Gray) Terrac.	Solanaceae	Tomatillo, Wolfberry	O	C	C	O	
Lycium exsertum Gray	Solanaceae	Tomatillo, Wolfberry	U	O	C	O	
Lycium fremontii Gray	Solanaceae	Fremont Thornbush	R	U	U	R	
Nicotiana trigonophylla Dunal.	Solanaceae	Desert Tobacco	U	U	O	U	
Typha domingensis Pers.	Typhaceae	Southern Cat-tail					O
Celtis pallida Torr.	Ulmaceae	Desert Hackberry	R	C	O	O	U
Bowlesia incana Ruiz & Pavon	Umbelliferae	Hairy Bowlesia	O	C	C	O	O
Daucus pusillus Michx.	Umbelliferae	American Carrot	U	O	O	U	
Aloysia wrightii (Gray) Heller	Verbenaceae	Oreganillo			R	R	
Phoradendron californicum Nutt.	Viscaceae	Desert Mistletoe	O	O	C	O	
Larrea divaricata Cav. ssp. *tridentata* (Ses.& Moc ex DC.) F.& L.	Zygophyllaceae	Creosote Bush	C	O	C	C	

APPENDIX C

STUDY AREA SPECIES: WILDLIFE

Appendix C: List of bird and mammal species potentially using the study area for breeding, foraging, migration or wintering. Only species potentially using the riparian communities are listed. Those potentially using the upland community are not listed. List of species with scientific and common names from Ohmart and Zisner (1993), and Hoffmeister (1986).

I	224.521	*Prosopis velutina* Association		
II	224.523	*Cercidium floridum* Association	X	Potentially Present
III	224.524	*Cercidium microphyllum* Association		
IV	224.531	*Populus fremontii-Salix gooddingii* Association		

Genus or Species	Common Name	I	II	III	IV
Birds					
Ardea herodias	Great Blue heron		X		X
Casmerodius albus	Great Egret		X		X
Egretta thula	Snowy Egret		X		X
Butorides striatus	Green-backed Heron		X		X
Nycticorax nycticorax	Black-crowned Night Heron		X		X
Anas crecca	Green-winged Teal		X		X
Anas discors	Blue-winged Teal		X		X
Anas platyrhynchos	Mallard		X		X
Anas acuta	Northern Pintail		X		
Anas cyanoptera	Cinnamon Teal		X		X
Anas ctypeata	Northern Shoveler		X		
Anas srepera	Gadwall		X		X
Anas americana	American Wigeon		X		X
Aythya collaris	Ring-necked Duck		X		X
Aythya	Scaup		X		X
Lophodytes curcullatus	Hooded Merganser		X		X
Mergus merganser	Common Merganser		X		X
Oxyura jamaicensis	Ruddy Duck		X		
Circus cynneus	Northern Harrier				X
Accipiter cooperii	Cooper's Hawk	X	X	X	X
Parabuteo unicinctus	Harris Hawk	X	X	X	X
Falco sparverius	American Kestrel	X	X	X	X
Callipepla gambeli	Gambel's Quail	X	X	X	X
Buteo jamaicensis	Red-Tailed Hawk	X	X	X	X
Rallus limicola	Virginia Rail		X		X
Porzana carolina	Sora		X		X
Gallinula chloropus	Common Moorhen		X		
Fulica americana	American Coot		X		
Charadrius semipalmatus	Semipalmated Plover		X		
Charadrius vociferus	Killdeer		X		X
Himantopus mexicanus	Black-necked Stilt		X		
Recurvirostra americana	American Avocet		X		
Tringa melanoleuca	Greater Yellowlegs		X		
Tringa flavipes	Lesser Yellowlegs		X		
Actitis macularia	Spotted Sandpiper		X		X
Calidris mauri	Western Sandpiper		X		
Calidris minutilla	Least Sandpiper		X		

I	224.521	*Prosopis velutina* Association		
II	224.523	*Cercidium floridum* Association	X	Potentially Present
III	224.524	*Cercidium microphyllum* Association		
IV	224.531	*Populus fremontii-Salix gooddingii* Association		

Genus or Species	Common Name	I	II	III	IV
Gallinago gallinago	Common Snipe		X	X	X
Zenaida asiatica	White-winged Dove	X	X	X	X
Zenaida macroura	Mourning Dove	X	X	X	X
Columbina passerina	Common Ground Dove		X		
Coccyzs americanius	Yellow-billed Cuckoo				X
Tyto alba	Common Barn Owl	X			X
Otus kennicottii	Western Screech Owl	X			X
Bubo virginianus	Great Horned Owl	X	X	X	X
Micrathene whitneyi	Elf Owl	X	X	X	X
Asio flammeus	Short-eared Owl	X			X
Chordeiles acutipennis	Lesser Nighthawk	X	X	X	X
Calypte anna	Anna's Hummingbird	X	X	X	X
Archilochus alexandri	Black-chinned Hummingbird	X	X	X	X
Ceryle alcyon	Belted Kingfisher		X		X
Melanerpes uropygialis	Gila Woodpecker	X	X	X	X
Picoides scalaris	Ladder-backed Woodpecker		X		X
Colapter auratus	Northern Flicker	X	X	X	X
Empidonax wrightii	Gray Flycatcher	X	X		X
Sayornis nigricans	Black Phoebe	X	X		X
Sayornis saya	Says Phoebe	X	X	X	X
Pyrocephalus robinus	Vermillion Flycatcher	X	X	X	X
Myiarchus cinerascens	Ash-throated Flycatcher	X	X	X	X
Tyrannus vociferans	Cassin's Kingbird	X	X	X	X
Tyrannus verticalis	Western Kingbird	X	X	X	X
Progne subis	Purple Martin		X		X
Tachycineta bicolor	Tree Swallow		X		X
Hirundo pyrrhonota	Cliff Swallow		X		X
Corvus	Common Raven	X	X	X	X
Auriparus flaviceps	Verdin	X	X	X	X
Campylorhynchus brunneicapillus	Cactus Wren	X	X	X	X
Thryomanes bewickii	Bewick's Wren	X	X		X
Cistothorus palustris	Marsh Wren		X		X
Regulus calendula	Ruby-crowned Kinglet	X	X	X	X
Polioptila caerulea	Blue-gray Gnatcatcher	X	X	X	X
Polioptila melanura	Black-tailed Gnatcatcher	X	X	X	X
Mimus polyglottos	Northern Mockingbird	X	X	X	X
Toxostoma cirvirostra	Curve-billed Thrasher	X	X	X	X
Toxostoma bendirei	Bendire's Thrasher	X	X	X	X
Anthus rubescens	American Pipit		X		X
Phainopepla nitens	Phainopepla	X	X	X	X
Lanius ludovicianus	Loggerhead Shrike	X	X	X	X
Vireo bellii	Bell's Vireo		X		X

I	224.521	*Prosopis velutina* Association		
II	224.523	*Cercidium floridum* Association	X	Potentially Present
III	224.524	*Cercidium microphyllum* Association		
IV	224.531	*Populus fremontii-Salix gooddingii* Association		

Genus or Species	Common Name	I	II	III	IV
Vireo solitarius	Solitary Vireo				X
Vermivora celata	Orange-crowned Warbler	X	X		X
Vermivora ruficapilla	Nashville Warbler	X	X		X
Vermivora luciae	Lucy's Warbler	X	X		X
Dendroica petechia	Yellow Warbler	X	X		X
Dendroica coronata	Yellow-rumped Warbler	X	X	X	X
Geothylpis trichas	Common Yellowthroat	X	X		X
Wilsonia pusilla	Wilson's Warbler	X	X		X
Icteria virens	Yellow-breasted Chat		X		X
Piranga rubra	Summer Tanager				X
Cardinalis cardinalis	Northern Cardinal	X	X	X	X
Calamospiza melanocorys	Lark Bunting	X	X	X	X
Pipilo aberti	Abert's Towhee	X	X	X	X
Amphispiza bilineata	Black-throated Sparrow	X	X	X	X
Amphispiza belli	Sage Sparrow	X	X	X	X
Spizella breweri	Brewer's Sparrow	X	X	X	X
Junco hyemalis	Dark-eyed Junco	X	X	X	X
Passerculus sandwichensis	Savannah Sparrow	X	X	X	X
Melospiza melodia	Song Sparrow	X	X	X	X
Melospiza lincolnii	Lincoln's Sparrow	X	X	X	X
Zonotrichia leucophrys	White-crowned Sparrow	X	X	X	X
Agelaius phoeniceus	Red-winged Blackbird		X		X
Sturnella	Meadowlark	X	X	X	
Euphagus cyanocephalus	Brewer's Blackbird	X	X	X	X
Quiscalus mexicanus	Great-tailed Grackle	X	X	X	X
Molothrus ater	Brown-headed Cowbird	X	X	X	X
Icterus eucullatus	Hooded Oriole				X
Icterus galbula	Northern Oriole				X
Carpodacus mexicanus	House Finch	X	X	X	X
Carduelis psaltria	Lesser Goldfinch	X	X	X	X
Amphibians and Reptiles					
Ambystoma tigrinum	Tiger Salamander		X		X
Scaphiopus couchi	Couch's Spadefoot		X		X
Bugo alvarius	Sonoran Desert Toad		X		X
Bufo punctatus	Red-spotted Toad		X		X
Bufo cognatus	Great Plains Toad		X		X
Rana yavapiensis	Leopard Frog		X		X
Kinostemon sonoriense	Sonoran Mud Turtle		X		X
Coleonyx variegatus	Banded Gecko	X	X	X	X
Dipsosaurus dorsalis	Desert Iguana	X	X	X	X
Urosaurus ornatus	Tree Lizard	X	X	X	X

I	224.521	*Prosopis velutina* Association		
II	224.523	*Cercidium floridum* Association	X	Potentially Present
III	224.524	*Cercidium microphyllum* Association		
IV	224.531	*Populus fremontii-Salix gooddingii* Association		

Genus or Species	Common Name	I	II	III	IV
Sceloporus magister	Desert Spiny Lizard				
Sceloporus clarki	Clark's Spiny Lizard				
Uta stansburiana	Side-blotched Lizard				
Crotaphytus collaris	Collared Lizard	X	X	X	X
Cnemidophorus tigris	Western Whiptail	X	X	X	X
Sauromaius obesus	Chuckwalla	X	X	X	X
Heloderma suspectum	Gila Monster	X	X	X	X
Thamophis	Garter Snake	X	X	X	X
Sonora semiannulata	Western Ground Snake	X	X	X	X
Crotalus viridis cerberus	Arizona Black Rattlesnake	X	X	X	X
Mammals					
Myotis velifer	Cave Myotis	X	X	X	X
Lasiurus blossevillii	Western Red Bat	X	X	X	X
Pipistrellus hesperus	Western Pipistrelle	X	X	X	X
Antrozous pallidus	Pallid Bat	X	X	X	X
Lasiurus cinereus	Hoary Bat	X	X	X	X
Myotis yumanensis	Yuma Myotis	X	X	X	X
Lasiurus ega	Southern Yellow Bat	X	X	X	X
Peromyscus eremicus	Cactus Mouse	X	X	X	X
Perognathus penicillatus	Desert Pocket Mouse	X	X	X	X
Onychomys torridus	Southern Grasshopper Mouse	X	X	X	X
Neotoma albigula	White-throated Woodrat	X	X	X	X
Sylvilagus auduboni	Desert Cottontail	X	X	X	X
Canis latrans	Coyote	X	X	X	X
Spilogale gracilis	Western Spotted Skunk	X	X	X	X
Urocyon cinereogenteus	Gray Fox	X	X	X	X
Vulpes macrotus	Kit Fox	X	X	X	X
Felis rufus	Bobcat	X	X	X	X
Tayassu tajacu	Javelina	X	X	X	X
Odocoileus hemionus	Mule Deer	X	X	X	X

APPENDIX D

DATA COLLECTION INSTRUMENTS

RIPARIAN AREAS OF THE CAVE CREEK SYSTEM

Data Collection Form

Team Members:

_____ _____

_____ _____

_____ _____

Site Name: _____

Date:____/____/____ Start Time: _____ End Time: _____
day mo yr

Weather Conditions: _____

Overview:
Distance in blocks or miles (specify) from:

Residential _____ Commercial _____ Industrial _____

Buildings_____ Road/bridge/tower _____

Water_____ Other (specify)_____

Neighboring Property:

North _____

South _____

East _____

West _____
(Developed, undeveloped, desert, creekbed, bosque, etc.)

Sounds: _____
(Street noise, machinery, birds, livestock, etc.)

Smells: _____
(Soil, water, plants, livestock, chemical, etc.)

Other features: _____

_____
(Steepness of terrain, difficulty in finding site, walking and moving around, etc.)

Site coverage: _____
(Walk perimeter, straight across, follow trails, wander, select observation points, etc.)

Cover Type:

Desert:

❑ Arizona Upland

Riparian:

❑ Mesquite Bosque
❑ Cottonwood-Willow
❑ Open Creekbed
❑ Slope: ❑ North- or East-facing ❑ South- or West-facing

Trees:

Tree density: ❑ Closed ❑ Open ❑ Scattered

Percent deciduous species: _____

Dominant species (20% or more cover): _____

_____

Rare or unique species: _____

Approximate height of trees: _____

Shrubs: (Woody vegetation 1-5 ft. tall)

Shrub density: ❑ Closed ❑ Open ❑ Scattered

Percent deciduous species: _____

Dominant species (20% or more cover): _____

_____

Rare or unique species: _____

Ground Cover: (Herbaceous vegetation)

Percent of ground covered by vegetation: _____

Percent of bare ground: _____

Percent of rocky outcrop: _____

Dominant herbaceous species: _____

Rare or unique species: _____

_____

Nonvascular plants present: ❑ Algae ❑ Lichen ❑ Bryophytes

Wildlife

List rare or unique species of wildlife:

Arthropods _____

Fish _____

Reptiles _____

Amphibian _____

Birds _____

Mammals _____

Habitat

Snags (dead wood 4 inches or larger at base)

❑ Abundant ❑ Common ❑ Uncommon ❑ Rare

Down wood: ❑ Abundant ❑ Common ❑ Uncommon ❑ Rare

Rocks: ❑ Abundant ❑ Common ❑ Uncommon ❑ Rare

Barriers: ❑ Roads ❑ Walls ❑ Fences ❑ Other _____

Evidence of Human Use:

Recent/current:

❑ Informal trails ❑ Formal trails ❑ Debris/trash ❑ Structures

❑ Fire damage ❑ Campsites ❑ Vandalism ❑ Erosion ❑ Plantings

❑ Farming ❑ Ranching ❑ Logging ❑ Residence ❑ Other_____

Historical (last 125 years or so):

❑ Farming ❑ Ranching ❑ Logging ❑ Residence ❑ Other_____

❑ Early roadways/trails ❑ Metal, glass, etc. ❑ Corrals, etc.

Archaeology:

❑ Permanent habitations ❑ Potsherds, metates, etc. ❑ Petroglyphs

FIELD DATA

Plant Checklists

Trees:

Mark with:
A = Abundant
C = Common
O = Occasional
U = Uncommon
R = Rare

____ Arizona Sycamore
____ Fremont Cottonwood
____ Goodding's Willow
____ Ocotillo
____ Saguaro
____ Tamarisk, Salt Cedar
____ Velvet Ash
____ Velvet Mesquite
____ Other_____

Shrubs:

____Barrel Cactus
____Buckhorn Cholla
____Burro Brush
____Canyon Bursage
____Catclaw Acacia
____Chain Fruit Cholla
____Christmas Cholla
____Creosote Bush
____Desert Broom
____Other_____

____Desert Hackberry
____Desert Honeysuckle
____Desert Mistletoe
____Engelm. Prickly Pear
____Flattop Buckwheat
____Greythorn
____Joint-fir
____Jojoba
____Other_____
____Other_____

____Seep Willow
____Southern Cattail
____Teddy-bear Cholla
____Texas Virgin Bower
____Tomatillo, Wolfberry
____Triangle-leaf Bursage
____Turpentine Bush
____White Ratany
____Other_____
____Other_____

Herbaceous plants:

____American Carrot
____Annual Bluegrass
____Aster
____Bearded Cryptantha
____Bermuda Grass
____Bluedicks
____Bricklebush
____Bulrush
____Burst-wort
____Canaigre
____Clematis
____Coast Fiddleneck
____Cocklebur
____Comb Burs
____Common Horehound
____Crown Beard
____Desert Mallow
____Desert Marigold
____Desert Straw
____Desert Tobacco
____Downy Chess
____Eriastrum
____Other_____
____Other_____

____Filaree
____Fishhook Cactus
____Five-winged Ringstem
____Fleabane
____Goldeneye
____Groundsel
____Hairy Bowlesia
____Hedgehog Cactus
____Henbit
____Isocoma
____Jimsonweed
____London Rocket
____Lotus/Trefoil
____Lupine
____Mediterranean Grass
____Milkweed, Climbing
____Milkweed, Rambling
____Monkey Flower
____Odora
____Paperflower
____Pineapple Weed
____Plantain
____Other_____
____Other_____

____Plantain, Wooly
____Prostrate pigweed
____Red Brome
____Ripgut Grass
____Rock Cress
____Sand Peppergrass
____Slimleaf Bursage
____Small-fl. Phacelia
____Snakeweed
____Southern Cattail
____Spurge
____Thistle
____Tocolote
____Tumbleweed
____Water-cress
____Whispering Bells
____Whitlow Grass
____Wild Barley
____Wild Cucumber
____Wild Oat
____Wishbone Bush
____Yellow Sweet Clover
____Other_____
____Other_____

Animal Checklists

Birds: H = Heard S = Seen

____Blackbird, Brewer's
____Blackbird, Yellow-headed
____Bluebird, Mountain
____Bluebird, Western
____Bunting, Lark
____Bunting, Lazuli
____Cardinal
____Chat, Yellow-breasted
____Cowbird, Bronzed
____Cowbird, Brown-headed
____Dove, Inca
____Dove, Mourning
____Dove, White-winged
____Egret, Snowy
____Falcon, Prairie
____Finch, House
____Flicker, Northern
____Flycatcher, Ash-throated
____Flycatcher, Cordilleran
____Flycatcher, Brown-crested
____Gnatcatcher, Black-tailed
____Goldfinch, American
____Goldfinch, Lawrence's
____Goldfinch, Lesser
____Grackle, Great-tailed
____Grosbeak, Black-headed
____Hawk, Cooper's
____Hark, Harris'
____Hawk, Red-tailed
____Hawk, American Kestrel
____Heron, Great Blue
____Hummingbird, Anna's
____Hummingbird, Black-chinned
____Hummingbird, Costa's
____Hummingbird, Rufous
____Jay, Scrub
____Jay, Steller's
____Junco, Dark-eyed
____Kingbird, Western
____Kinglet, Ruby-crowned
____Meadowlark, Western
____Mockingbird
____Nighthawk, Lesser
____Oriole, Bullock's
____Oriole, Hooded
____Oriole, Scott's
____Owl, Elf
____Owl, Great Horned
____Owl, Long-eared
____Owl, Screech
____Peewee, Western Wood
____Phainopepla
____Phoebe, Black
____Phoebe, Say's
____Pigeon, Band-tailed
____Poor-will
____Pyrrhuloxia
____Quail, Gambel's
____Raven, Common
____Roadrunner, Greater
____Robin, American
____Shrike, Loggerhead
____Sparrow, Black-throated
____Sparrow, Brewer's
____Sparrow, Chipping
____Sparrow, Fox
____Sparrow, Harris'
____Sparrow, House
____Sparrow, Lark
____Sparrow, Lincoln's
____Sparrow, White-crowned
____Starling
____Swallow, Barn
____Swallow, Rough-winged
____Swallow, Tree
____Swallow, Violet-green
____Tanager, Scarlet
____Thrasher, Bendire's
____Thrasher, Curve-billed
____Thrasher, Sage
____Towhee, Abert's
____Towhee, Canyon
____Towhee, Green-tailed
____Towhee, Rufous-sided
____Verdin
____Vireo, Bell's
____Vireo, Solitary
____Vireo, Warbling
____Vulture, Turkey
____Warbler, _____
____Warbler, _____
____Waxwing, Cedar
____Woodpecker, Gila
____Woodpecker, Ladder-backed
____Wren, Bewick's
____Wren, Cactus
____Wren, Canyon
____Wren, House
____Wren, Rock
____Yellowthroat

Mammals Checklist

Evidence for mammals can take many forms: Sighting, hearing, scent, tracks, scat, nest or lair, carcass, or other evidence. List any and all evidence.

	Type(s) of evidence
Chiroptera:	
❑ Bat, Arizona Myotis	
❑ Bat, Mexican Free-tailed	
❑ Bat, Western Pipistrel	
Carnivores:	
❑ Badger	
❑ Bobcat	
❑ Coyote	
❑ Fox, Gray	
❑ Fox, Kit	
❑ Mountain Lion	
❑ Raccoon	
❑ Ringtail	
❑ Skunk, Spotted	
❑ Skunk, Striped	
Rodents:	
❑ Jackrabbit, Black-tailed	
❑ Cottontail, Desert	
❑ Mouse, Arizona Pocket	
❑ Mouse, Cactus	
❑ Mouse, Deer	
❑ Mouse, Grasshopper	
❑ Mouse, Little pocket	
❑ Rat, Desert Kangaroo	
❑ Rat, Merriam	
❑ Squirrel, Harris' Antelope Ground	
❑ Squirrel, Rock	
❑ Squirrel, Round-tailed Ground	
❑ Woodrat, White-throated	
Artiodactyla:	
❑ Javelina (Collared Peccary)	
❑ Deer, Blacktailed Mule	

Stream Characteristics

A. Springs present? ❑ Yes ❑ No ❑ Maybe

B. Water appearance: ❑ Clear ❑ Scummy ❑ Foamy ❑ Muddy ❑ Milky

❑ Oily sheen ❑ Green ❑ Other_____

C. Stream bottom color: ❑ Green ❑ Yellow ❑ Orange or red ❑ Brown ❑ Black

❑ Other_____

D. Algae: ❑ None ❑ Green, submerged ❑ Yellowish, surface

E. Water odor: ❑ None ❑ Rotten egg ❑ Musky ❑ Acrid ❑ Chlorine ❑ Other

F. _____ Estimated depth of water (ft.) **G.** _____ Average stream width (ft.)

H. Stream bottom: ❑ Rock ❑ Gravel ❑ Sand ❑ Mud ❑ Other_____

I. Stream flow: ❑ Fast ❑ Slow ❑ Pools

J. Stream cover: ❑ Fully shaded ❑ Partially shaded ❑ Partially exposed ❑ Fully exposed

K. Stream channel alterations: ❑ None ❑ Dredged/ditched ❑ Culverts ❑ Other

L. Structures or barriers in streams: ❑ Dam ❑ Bridge ❑ Low-water crossing

Litter items in representative 100-foot stretch of stream:

M. Paper, small trash: ❑ 0-5 ❑ 5-10 ❑ 10-50 ❑ over 50 _____

N. Cans, bottles ❑ 0-5 ❑ 5-10 ❑ 10-50 ❑ over 50 _____

O. Large items ❑0-5 ❑ 5-10 ❑ 10-50 ❑ over 50 _____

P. Large organic debris: ❑ None ❑ Log piles ❑ Tree roots ❑ Stumps

Q. Trash dumping: ❑ Trash piles ❑ Landscaping debris ❑ Other_____

R. Nonpoint pollution: Are there any nearby sources of surface contamination?:

❑ Golf courses ❑ Livestock pens ❑ Other_____

S. Water uses: ❑Recreation ❑ Swimming ❑ Fishing ❑ Drinking water

❑ Industry ❑ Irrigation ❑ Livestock ❑ Other_____

T. Wastewater: Are there any pipes emptying into the stream? ❑ Yes ❑ No

APPENDIX E

FIELD TRIP REPORTS

Field Trip Report: Spur Cross
7th Grade Group--Mesquite Bosque
17 May 1993 2:30-4:00 PM

Team members:
Mary Hittner
Patricia Bello
Ross Robbins

Site description: It was hot with a slight breeze from the south. Residential area was within five miles. There were houses to the north. Open desert to the south, west and east. Snags and down wood were common. Rocks were abundant. Erosion was evidence of human use.

Sound: Water running
Smell: Trees and rain.

Trees: Closed tree canopy, 95% deciduous. Identified 2 species of trees. Approximate height of trees was 12-17 feet. Rare or unique species was the saguaro.

Shrubs and Ground Cover: Identified 12 species of shrubs. Scattered shrub density, 95% deciduous. Dominated by Creosote. Rare or unique species were Banana Yucca and the Catclaw Mimosa. 60% of ground covered by vegetation, 15% bare ground cover, 25% of rocky outcrop. Dominant herbaceous species were Bermuda grass and Red Brome. Rare or unique species was Wire Lettuce.

Wildlife: Identified 3 species of birds: Cardinal, Phainopepla, and Turkey Vulture. 2 arthropods were identified: Honey bee and the Yellow Jacket. Identified 1 reptiles, the Blue Belly lizard. No amphibians were seen. Javelina tracks and horse scat were identified.

Field Trip Report: Spur Cross Ranch
Open Creekbed Zone
17 May 1993 2:30-4:30 PM

Team Members:
Lura Dulaney
Tamara Peterson
Matt Samsill

Site Description: The Spur Cross Ranch area of the Cave Creek Wash is an inviting area with mature Fremont Cottonwood trees, Velvet Ash trees, and Goodding's Willows lining the sides of the creek bed. The conditions for this field trip were breezy and hot. There were a lot of flying insects. The nearest building was a residential building approximately 1/4 mile away in a northern direction. We observed the songs of birds. There were no obvious smells.

Trees:
The trees were scattered along the creek sides. The percentage of deciduous species was 75%. The dominant species was probably Cottonwood. The average height of the trees observed in this area was 25 feet. The Goodding's Willow was less common than the Cottonwood and the Velvet ash was the less common.

Shrubs:
The Burro Brush was observed but it was rare.

Herbaceous plants:
Bermuda Grass was abundant. A Monkey Flower was sighted. We located Water-Cress in the creek. It was uncommon. There was Cattail in the creek also. They were occasional.

Animals:
We spotted a hummingbird that was black and green. We were unable to make an accurate identification. We also observed fish in the creek. Some looked like minnows and others were up to 5 inches long. We saw a Blue Belly lizard.

Stream characteristics:
We did not observe any springs. The water in the creek appeared clear with just a little yellowish tinge. There was a lot of green algae. The water did not have any odor. The estimated depth of the water was 3 feet. The average stream width was 24 feet. The stream bottom was covered with large rocks, gravel, and sand. The flow of the stream was medium. The stream channel was fully exposed to the sun. There were no channel alterations. We observed 5-10 cans or bottles as litter items. There was an old car that was littering the stream. We did not observe any trash dumping or nonpoint pollution. This water is used for recreation: swimming. We did not see any pipes emptying into the stream.

Field Trip Report: Spur Cross
Cottonwood/Willow group
17 May 1993 3:00-4:00

Team Members:
Pam Missari
Erika Parkin
Katie Lawson

Site Description: The area was covered with various shrubs and trees. Some trees are Velvet Ash and Fremont Cottonwood. Some shrubs are Barrel Cactus, Catclaw Acacia, Desert Hackberry and a Teddy Bear Cholla. There was one spring present. The water was clear and a little foamy. The stream color on the bottom was brown and a yellowish alga covered some of the bottom and the rest of the creek bottom was covered with gravel. The stream flow was fast at some spots but barely moving at others. The stream was partially shaded. There were no dams or bridges. There were sightings of Verdin and Quail. We saw two types of reptiles, a lizard and a toad.

Information found:
Fremont Cottonwood and Goodding's Willow were common. Occasionally there was a Velvet Mesquite and a Velvet Ash tree. Saguaros and Arizona Sycamores were rare.

The Desert Broom was a rare shrub. The Rush and Cattail were common herbaceous plants. So was the Bermuda. There was an occasional Cocklebur and sometimes an Indian Paintbrush. Wild Oats were common, too. Buckwheat was another of the many plants that we saw.

The trees were scattered about. There were times when they lined the creek like a fence. Most of the trees were more than 15-20 feet tall. 75% of the ground area was covered by vegetation 20% had a rock outcrop. Only 5% was bare. Maybe even less.

We identified some evidence of humans, a campfire. We also saw a jackrabbit and a few small lizards. We identified some birds also: a Verdin and a Cactus Wren. There were few birds due to the mid-day heat.

We noticed that some of the trees were knocked down due to the floods a few weeks ago. We hypothesized that the creek was twice its size when it rained. There was also some garbage like metal and glass. There was also evidence of old trails and roadways.

APPENDIX F

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LITERATURE CITED

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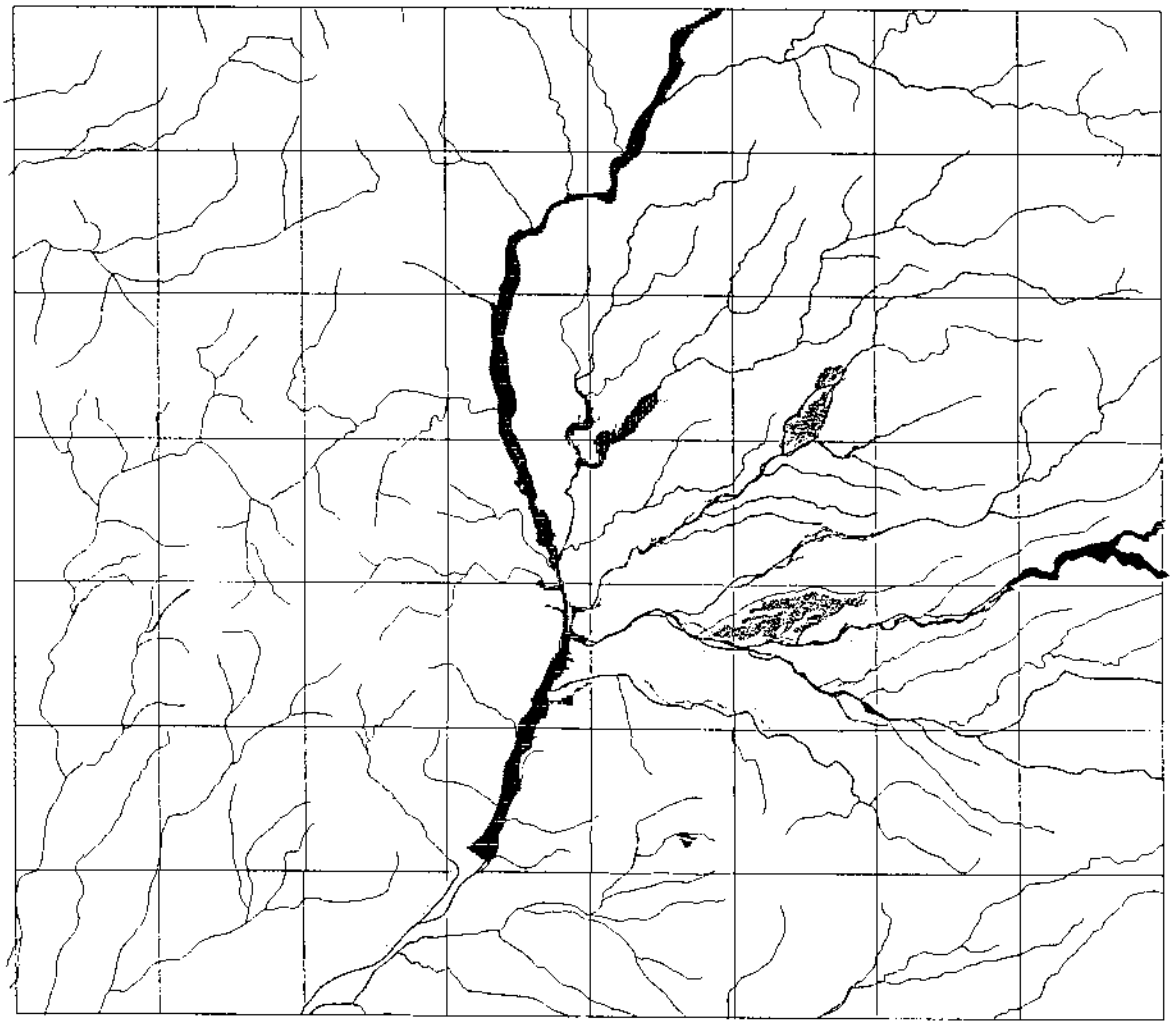
APPENDIX G

VEGETATIVE COMMUNITIES & FLOOD PLAIN

Vegetative Communities & Flood Plain



LEGEND

Vegetative Communities
- Open Sand
- Palo Verde-Mixed Cacti ("Arizona Upland") Series
- Populus fremontii-Salix gooddingii Association
- Prosopis velutina Association
- Prosopis velutina-Mixed Short Tree Association
- Streams
- Flood Plain
- Sections

N

APPENDIX H

INDEX OF DIGITIZED MAP DIRECTORIES

INDEX TO GIS DATA

The following is an index to the geographic information system digitized data base developed in conjunction with the mapping and inventory project using ESRI's PC ARC-INFO. Access to the GIS data is available through the Arizona Game and Fish Department which funded the project and the Desert Foothills Land Trust.

The data is organized in a series of directories containing digitized maps of the study area with attributes. Accessibility requires use of ARC-INFO or ARC-VIEW software. Separate directories were created for each of the U.S. Geological Survey sections in the study area.

Directory Index

Description Source	Directory
Study Area Boundary Defines external limits of the study area.	**STUDAREA**
Control Grid USGS Section Lines	**SECTIONS**
Section Detail Maricopa County Assessor's Maps (updated to 1992) Town of Cave Creek Road Study	**S5301 – S6436**
Flood Plain Maricopa County Flood Control Maps	**FLOOD**
Soils Composition U.S. Soil Conservation Service	**SOILS**
Drainage System Centerlines USGS Topographic Maps Cave Creek Road Study	**DRAINS**
Vegetative Communities Desert Foothills Land Trust	**RIPARIAN**

APPENDIX I

NOTES REGARDING THE GIS DATA IN THIS STUDY

The geographic information system (GIS) data in this study is organized in a series of directories containing digitized maps of the study area with attributes. Accessibility requires the use of ARC/INFO or ARC/VIEW software. Separate directories were created for each of the seven main maps, and a further set of directories contains the 56 individual one square mile section maps which make up the study area. These section maps are especially convenient for more detailed viewing.

Each of the GIS maps of the study area is referred to as a "cover". Covers can be viewed on a computer screen or printed on a graphic printer or plotter. Covers can be viewed individually, or overlain on one another for comparison and analysis. Entire covers or selected portions of covers can be viewed

Access to the GIS data is available through the Arizona Game and Fish Department or the Desert Foothills Land Trust.

The maps used to create the covers were obtained through a variety of sources. The varied sources result in some alignment problems between some of the covers.

The vegetative communities cover (RIPARIAN) was mapped using 1/4–section aerial photos of the Town of Cave Creek, and 1–section aerial photos of the Town of Carefree. The photos were obtained from the respective town governments. Borders between vegetation types were identified on the photos, and the vegetation types determined by field study.

The Cave Creek photos cover all of Sections 21, 22, 27, 28, and 33, plus the southern half of Sections 15 and 16, the southeast quarter of Section 17, and the eastern southern half of Sections 15 and 16, the southeast quarter of Section 17, and the eastern half of Sections 20, 29, and 32, all in T6N R4E, G&SRB&M. The Carefree photos are from the following: T5N R4E, Sections 2, 3, and 4; T6N R4E: Sections 24, 25, 26, 34, 35, and 36; and T6N R4E: Section 31.

Riparian boundaries along Cave Creek outside the aerial photo boundaries were derived from Maricopa County Flood Control maps. The dominant plant community type was applied to the portions of the flood plain outside the areas covered by the aerial photos.

The study area boundaries (STUDAREA) and control grid (SECTIONS) were digitized directly from USGS maps. These two sources; the USGS quad maps and the aerial photos, align well along the section lines, but the topographic details do not always correlate with the aerial photos. The anomalies are especially apparent in the following portions of the maps, all in T6N R4E:

Section 23 SW $\frac{1}{4}$
Section 25 NW $\frac{1}{4}$ of SW $\frac{1}{4}$
Section 26 NW $\frac{1}{4}$
Section 27 SW $\frac{1}{4}$
Section 28 SW $\frac{1}{4}$
Section 29 NE $\frac{1}{4}$of NE $\frac{1}{4}$

The offsets are difficult to reconcile, as they are irregular in distance and direction of orientation. This problem is common in GIS mapping where multiple sources are used to assemble a set of maps covering the same area. Problems can arise from differences of scale, the quality of the original map, and the stability of the medium on which the original maps are printed.

The differences in scale of these two sources is significant. The 7.5 minute USGS maps are produced at a scale of 1:24000, while the scale of the Cave Creek aerial photos is 1:1200. The ratio between the USGS maps and the aerial photos is 20:1. The Carefree photos are scaled at 1:2400, a 10:1 ratio.

The flood plain (FLOOD) cover was provided by the Maricopa County Flood Control District, and was derived from 1:1200 scale maps from FEMA. For unknown reasons, it does not correlate well with either of the above. One location, in NW$\frac{1}{4}$ of the NW $\frac{1}{4}$ of Section 29, T6N R4E, has been professionally surveyed, and shows a substantial offset in this cover. Other unsurveyed field checks against creek beds and roads show offsets as well.

The drainage system centerlines (DRAINS) was derived from the same source, and also correlates poorly to both the USGS and aerial photo covers. A further problem with the DRAINS cover is the wide spacing of the nodes along the lines.

The soils cover (SOILS) was provided by the US Soil Conservation Service. The maps were created from aerial photos, and later ortho–rectified. The map scale is 1:24000.

Individual section coverages (S5301 – S6436) were provided by the Maricopa County Assessor's Office, updated to 1992. Where roads appear on the individual section maps, they correlate well with the aerial photos. In the southeast quarter of the study area, several of the borders between sections are not well aligned.

One further cover, (RIPSECT) was produced using the ARC/INFO "union" command to combine the RIPARIAN and SECTIONS covers.

SOURCES OF THE GIS DATA IN THIS STUDY

The geographic information system (GIS) data in this study is organized in a series of directories containing digitized maps of the study area with attributes. Accessibility requires the use of ARC/INFO or ARC/VIEW software. Separate directories were created for each of the seven main maps, and a further set of directories contains the 56 individual one square mile section maps which make up the study area. These section maps are especially convenient for more detailed viewing.

Each of the GIS maps of the study area is referred to as a "cover". Covers can be viewed on a computer screen or printed on a graphic printer or plotter. Covers can be viewed individually, or overlain on one another for comparison and analysis. Entire covers or selected portions of covers can be viewed.

Access to the GIS data is available through the Arizona Game and Fish Department or the Desert Foothills Land Trust.

The maps used to create the covers come from various sources. The varied sources resulted in some alignment problems between some of the covers.

The vegetative communities cover (RIPARIAN) was mapped using 1/4-section aerial photos of the Town of Cave Creek, and 1-section aerial photos of the Town of Carefree. The photos were obtained from the respective town governments. Borders between vegetation types were identified on the photos, and the vegetation types determined by field study.

The Cave Creek photos cover all of Sections 21, 22, 27, 28 and 33, plus the southern half of Sections 15 and 16, the southeast quarter of Section 17, and the eastern halves of Sections 20, 29 and 32, all in T6N R4E, G&SRB&M. The Carefree photos are from the following: T5N R4E: Sections 2,3 and 4. T6N R4E: Sections 24, 25 26, 34, 35 and 36. T6N R5E: Section 31.

Riparian boundaries along Cave Creek outside the aerial photo boundaries were derived from the Maricopa County Flood Control maps. The dominant community type was applied to the portions of the flood plain outside the areas covered by the aerial photos.

The study area boundaries (STUDAREA) and control grid (SECTIONS) come directly from USGS maps.

These two sources - USGS quad maps and the aerial photos - align well along the section lines, but the topographic details do not always correlate with the aerial photos. The anomalies are especially apparent in the following portions of the maps, all in T6N R4E:

Section 23 SW 1/4
Section 25 NW 1/4 of SW 1/4
Section 26 NW 1/4
Section 27 SW 1/4
Section 28 SE 1/4
Section 29 NE 1/4 of NE 1/4

The offsets are difficult to reconcile, as they are irregular in distance and direction of orientation. This problem is common in GIS mapping where multiple sources are used to assemble a set of maps covering the same area. Problems can arise from differences of scale, the quality of the original map, and the stability of the medium on which the original maps are printed.

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