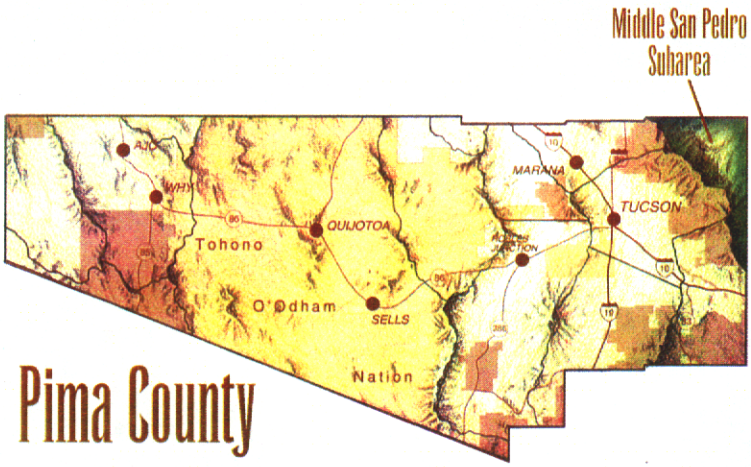
DRAFT

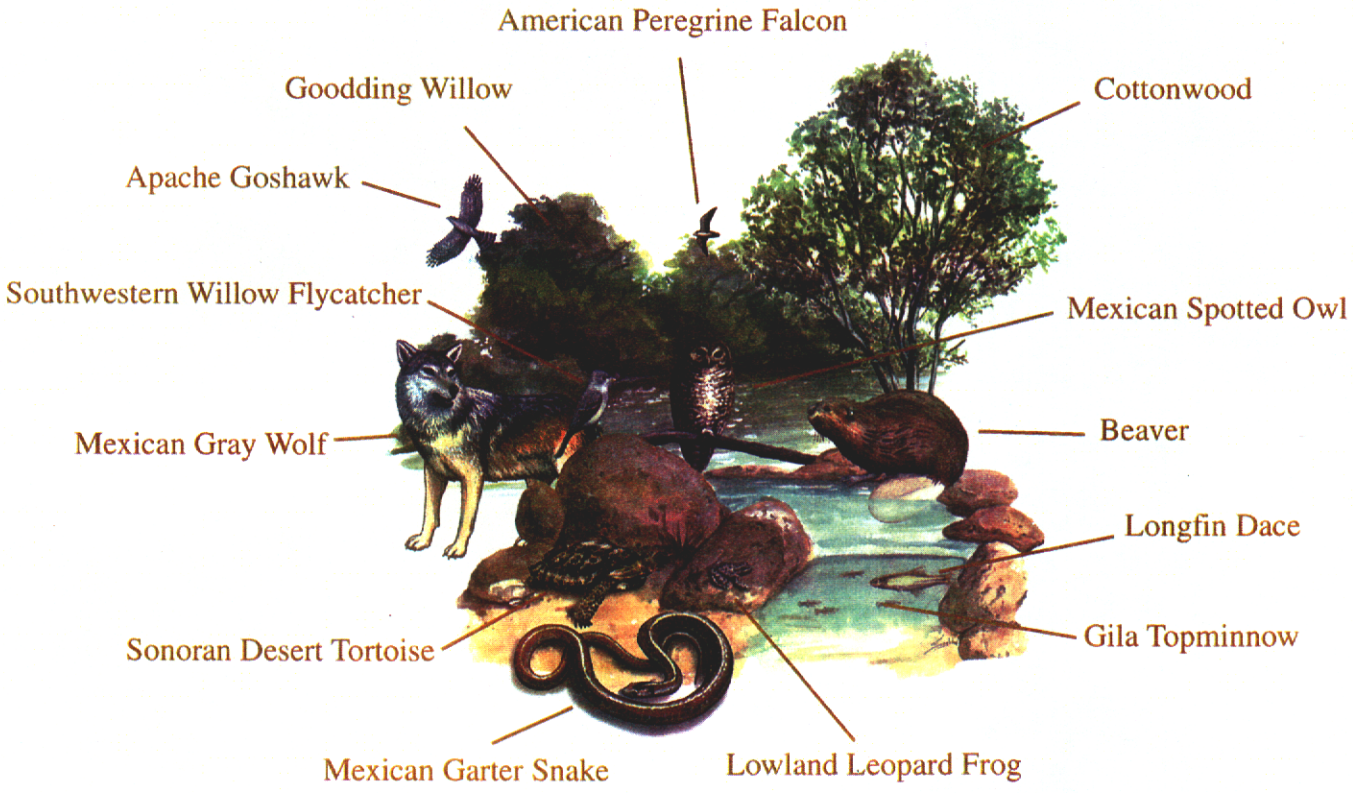
Resources of the Middle San Pedro Subarea

Sonoran Desert Conservation Plan

March 2000

Sonoran Desert Conservation Plan





Current and former inhabitants of the Middle San Pedro

MEMORANDUM

Date: March 24, 2000

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: *Resources of the Middle San Pedro*

I. Overview

This memorandum provides a brief summary of a compilation of resource investigations that have been submitted so far to help develop the Sonoran Desert Conservation Plan within the watershed planning area of the Middle San Pedro. The Steering Committee, interested members of the public, and stakeholding governmental entities are invited to submit additional documents and comments. Presentations at the March 25, 2000 Steering Committee meeting will be followed by subarea land panel meetings for all interested parties so that topics ranging from biological, to riparian, to ranch, to cultural, land and fiscal resources can be discussed in greater detail. Contributions resulting from the subarea process will be forwarded to the Steering Committee and Technical Teams. It is of particular importance during future land panel discussions to develop landowner goals and a realistic picture of options and constraints.

II. Habitat and Corridors Elements

The Nature Conservancy has provided an assessment of resources of the Middle San Pedro area. The subarea concept plan found at Attachment A is a synthesis of information about the historical, social, economic, and ecological backdrop of the Middle San Pedro area. As Mr. David Harris, the author of the report, states: "The San Pedro River is considered the best example of a desert riparian system remaining in the Southwest." The report:

- Characterizes ecological processes of the area by discussing riparian and aquatic communities, water quality, native fishes, the Lowland leopard frog, riparian birds, cotton-willow forest, grassland, wetlands, the role of beaver, issues of landscape connectivity between mountain ranges, and rare plants;

- Offers a stress assessment and proposes a number of conservation zones that achieve river protection, establish corridors, and achieve watershed enhancement; and

- Suggests strategies ranging from best management practices for ranching to conservation easements to fee acquisition to retirement of mining claims.

The Nature Conservancy report is a valuable contribution that will facilitate discussion at the subarea panel level and contribute to the efforts of the Science Technical Advisory Team.

III. Riparian Element

Attachment B is a chapter of a watershed and watercourse study by authors including Barbara Tellman of the Arizona Water Resources Research Center. Human impacts on the Middle San Pedro watershed are described, along with existing public and private land uses and projected land uses. The report identifies issues for discussion in achieving a goal of watercourse protection. Similar to the report by Mr. Harris, options include preservation, ranch conservation, rivercourse rehabilitation and mining issues. Ms. Tellman will discuss her work in the context of the Middle San Pedro area at the March 25, 2000 meeting.

IV. Ranch Conservation Element

Attachment C includes a descriptive summary of Ranching in the San Pedro Valley, drafted by Ms. Linda Mayro, the lead staff of the Ranch Conservation Team. Ranches in the area are described, along with grazing allotments, the carrying capacity per square mile by grazing allotment, the role of stock tanks and other ranch related resource topics.

V. Cultural Resources Element

Attachment D is a cultural and historic resources inventory report by Mr. David Cushman, the lead staff of the Cultural and Historic Resources Technical Team. Three kinds of resources are described: archaeological sites, historic resources, and traditional cultural resources, which are all defined and quantified within the report. This highly educational document includes maps that depict: the zone of archaeological sites along the San Pedro River; general archeological site and survey locations; and archaeological sites in relation to land ownership, vegetation communities, and water sources.

VII. Land Use Considerations

Attachment E is the contribution of Mr. Ben Changkakoti of the Planning Division. This report offers information about current and planned land use, zoning, housing types, viewsheds, infrastructure (including roads, access, water, sanitary sewer, natural gas, telephone and electricity), schools, parks, open space, real estate market conditions, capital improvement projects, and permits issued for residential and commercial activities.

VIII. Conclusion

After a number of subarea meetings are held, additional contributions and comments are received, discrepancies are eliminated in the data of individual reports and resource reports are perfected by the work of consultants and technical teams, a synthesizing subarea evaluation will be drafted by the land panel members and county staff that includes landowner goals and suggestions for conservation strategies. This initial presentation of resource information is intended to both educate and serve as an invitation to greater participation in crafting the Sonoran Desert Conservation Plan.

SONORAN DESERT CONSERVATION PLAN
MIDDLE SAN PEDRO RIVER
SUBAREA CONCEPT PLAN

List of Figures

List of Tables

List of Appendices

INTRODUCTION:

The Middle San Pedro subarea supports an array of habitats and species that by themselves are of great significance and are worthy of protection. However, to understand its true value the subarea must be placed in the context of the entire Middle San Pedro Basin which stretches from Pomerene in Cochise County to San Manuel in Pinal County (Figure 1). In this context the significance of related conservation work upstream and downstream of the subarea is realized and the tremendous value of proposed conservation work under the Sonoran Desert Conservation Plan can be fully appreciated as a key linkage in a larger multiple partnership effort. The task of this concept plan is to identify areas of high biodiversity and possible conservation opportunities.

The San Pedro River is considered the best example of a desert riparian system remaining in the Southwest. Except for minor agricultural diversions it is undammed and supports extensive areas of Fremont cottonwood (*Populus fremontii*)-Goodding willow (*Salix gooddingii*) riparian forest and mesquite bosque (*Prosopis velutina*). The river originates in the Mariquita, San Jose and Ajo mountains in Sonora and the Huachuca Mountains in Arizona. In 1988 U.S. Congress designated most of a 45-mile stretch of the river as the San Pedro Riparian National Conservation Area (NCA) administered by the Bureau of Land Management (BLM). This portion of the river has been documented as an important wildlife corridor as well as prime breeding habitat for many species. Additional pockets of similar habitat along the Lower San Pedro have been identified as significant and worthy of protection by the BLM, Bureau of Reclamation and agencies such as Pima County. (See map of Lower San Pedro, Appendix A)

The San Pedro River is considered a major migratory pathway for neotropical migratory birds. Riparian systems have migratory bird densities of up to 10 times that of other habitats (Stevens et al. 1977). This is particularly true during the spring migration as returning neotropical migratory birds funnel through these corridors where the only greenery is a thin band along waterways. More than 380 species of birds have been documented as occurring along or adjacent to the San Pedro River. Of the 27 species of bats known to occur in Arizona, 23 species are expected to occur in the Lower San Pedro River Basin due to the elevational gradient and diversity of riparian and xeric communities (Ronnie Sidner, pers. comm.).

The San Pedro River basin from Cascabel downstream to the Pima County line encompasses many significant ecological features, including two reaches of perennial river flow, intact cottonwood-willow riparian forest, several intact mesquite bosques, six side canyons with perennial flow and substantial occurrences of mixed broadleaf deciduous riparian forest, one of the finest remaining desert cienegas in the Southwest, and several rare or declining plant and animal species.

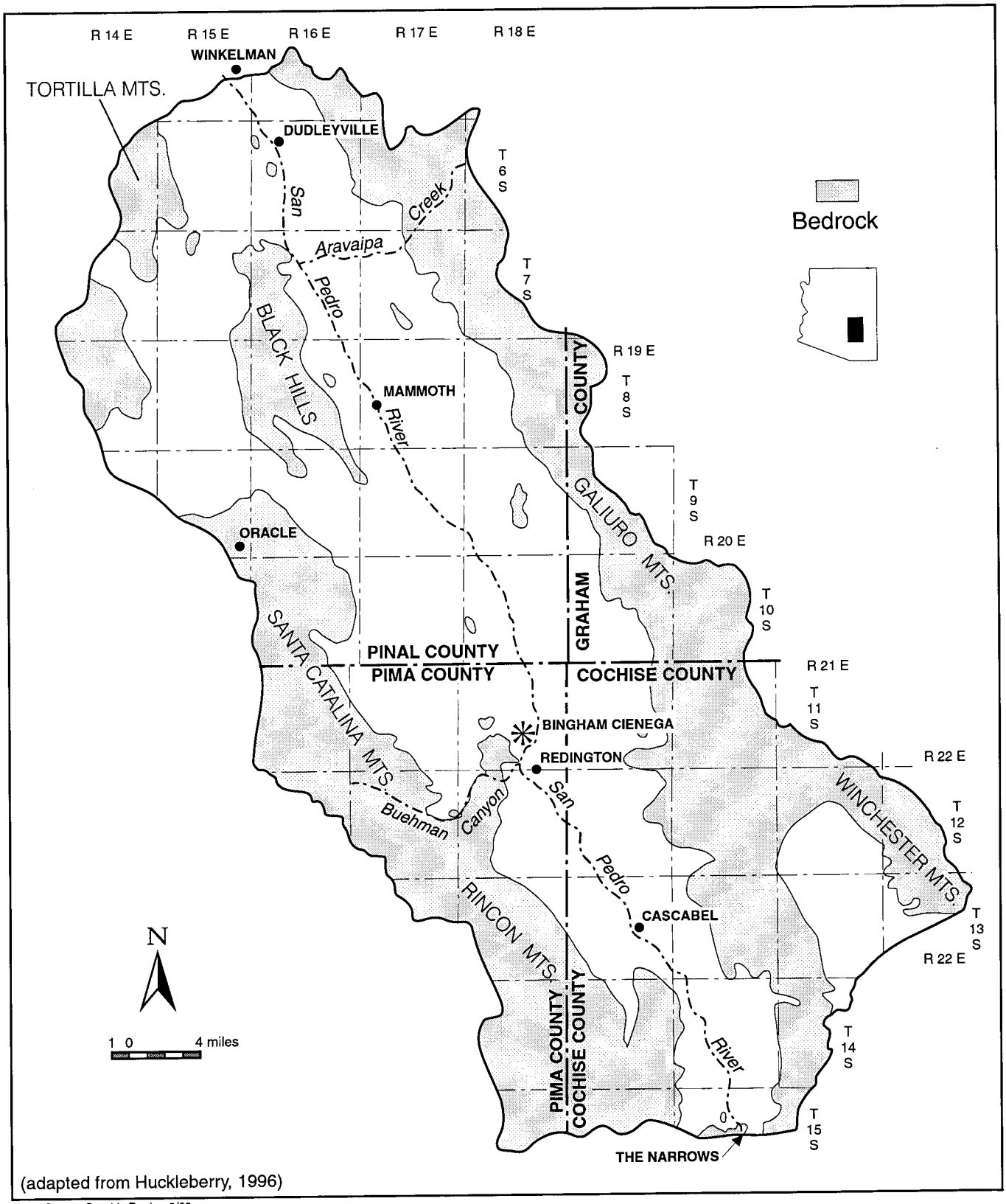


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FIGURE 1: Vicinity Map

Biogeographically, the Middle San Pedro River basin is a mosaic of Sonoran Desert, Chihuahuan Desert, and Apachean Highland ecoregions. This is the easternmost portion of the Sonoran Desert and westernmost portion of the Chihuahuan Desert. A northwest-southeast trending band of limestone occurs in the hills between the San Pedro and the Santa Catalinas and Rincons. Jim Malusa, a University of Arizona botanist, contends that the low-elevation eastern flank of the Santa Catalinas and Rincons is particularly significant because of this band of limestone which intersects perennial flow and riparian habitat. He is not aware of any other area in the Sonoran desert in Arizona with these conditions. Spanning this reach of river is a nearly unfragmented landscape linking the Galiuro and Winchester mountains with the Santa Catalina and Rincon mountains, which represents the narrowest intermountain distance between these ranges.

HISTORICAL CONTEXT:

Parks (1857) wrote that below Tres Alamos to the Gila River, "... the valley alternately widens and narrows, leaving beautiful oval meadows, separated by short stretches of bottom land, which have been narrowed down to a few hundred yards by bluffs of the impinging [mountain bluff] spurs. These meadows are grassy and inviting, and bounded by terraces. The terraces are sparsely covered with grama grasses, cereus, and Larrea. The valley bottom is generally smooth and open, with the stream bed curving through it, sometimes a few inches, others as much as 15 feet below the surface of the meadow.... in some meadows the stream spreads itself on a wide area, producing a dense growth of cotton-wood, willow and underbrush. The flow of water is not continuous. One or two localities were observed where it entirely disappeared, but to rise again a few miles distant.". Hutton (1859) on a wagon road trip down the river to the mouth of Aravaipa Creek describes the valley as varying from 0.25 miles to 3 miles wide, "... with broad rich meadows and well-timbered banks of cottonwood and ash., and sloping hillsides covered with luxuriant growth of grama and other grasses.". He encountered beaver dams that "... formed marshes densely timbered with cottonwood and ash.". Hutton also mentioned that the river "... disappeared in several places during August and September.

Beaver were abundant in the river, apparently so common that it was referred to at the time as the Beaver River (Pattie 1833). Several authors mention the abundance of fish, some up to 3 feet long. Historic records indicate that at least 12 native fish species, including the Colorado River squawfish, inhabited this river (Minckley 1973). After 1880, the river channel began to incise and widen, and base flows began to lower. During this time period, intensive livestock grazing began, which denuded vast areas, combined with prolonged drought conditions, extirpation of beaver and then heavy flooding that resulted in faster runoff and severe erosion.

SOCIAL, ECONOMIC, LEGAL, AND POLITICAL CONTEXT:

Land uses in the middle San Pedro River basin are primarily cattle ranching, alfalfa farming, low-density rural residential housing and conservation/preserve land. Ranching includes irrigation of pastures and croplands along the river as part of overall ranch operations. This area, in general, has been used for ranching and crop production since the late 1870s. Although present historically, irrigated agriculture has steadily expanded since the wide spread introduction of the high lift turbine pump in the 1940's.

The large ranch operations appear to be somewhat stable because they maintain irrigated pastures to allow upland perennial grasses time to recover from grazing pressure. The NRCS encourages ranchers to irrigate the river terrace lands in the summer months for this reason. This represents a tradeoff in impacts to resources. On the one hand conditions in the upland portions of the watershed may benefit. On the other, riparian resources and the highly productive terrace land communities have been greatly impacted. These impacts take two major forms. One is the loss of the actual terrace land habitat. Mesquite bosque or riparian grasslands that would occur on the terraces are converted to non native monocultures of alfalfa, grains, and pasture grasses. Second is the effect of irrigation pumping on the subflow in the stream alluvium. There is ample evidence to support the loss of surface flows in the system and along with that, the loss of native riparian habitats.

There also seems to be a trend toward subdivision of large agricultural properties for sale as smaller (40 to 200 acre) parcels. These smaller parcels are then subject to further subdivision to even smaller parcels. The land use then becomes rural residential and hobby ranching. One effect of this breakdown in parcel size on the natural resource base is to reduce management options and continuation of ecological processes at the landscape scale. Another possibly significant effect of the reduction of parcel size is to increase land values through out the area. The effect of increasing land values on the transition of open space land uses such as ranching to urban development is well discussed in *Ranching in Pima County, Arizona, A Conservation Objective of the Sonoran Desert Conservation Plan.* By Linda Mayro and Micaela K. McGibbon. Ranches upstream of this study area and nearer to Benson have already fallen to this syndrome. Within the subarea the Bellota Ranch was close to meeting this same fate but for the intervention of The Nature Conservancy, the City of Tucson and other agency and private partners. Other ranches within the subarea are also vulnerable and care should be taken to assess the possibilities to protect the open space land uses that are currently in place.

Recreation in this area includes hunting (autumn), hiking and camping, mountain biking, and OHV use. The Redington Pass area is used increasingly as Tucson population and recreational tourism grow. Historically, mining occurred in the foothills and mountain ranges, and an ongoing exploration for ore in Buehman Canyon

continues. Approximately 60% of the mineral rights on private and publically owned lands are held by the Federal government.

Zoning in this part of Pima County is Rural Homesite (RH) – a low density residential classification, generally allowing for lot sizes of 4 acres. The same zoning applies to adjacent areas of Cochise County.

Land ownership in the middle reach of the San Pedro River watershed breaks down the following way (approximation):

State of AZ	34.0%	(91 sections)
USFS	47.0%	(123 ")
Private	13.3%	(35 ")
NPS	5.7%	(15 ")

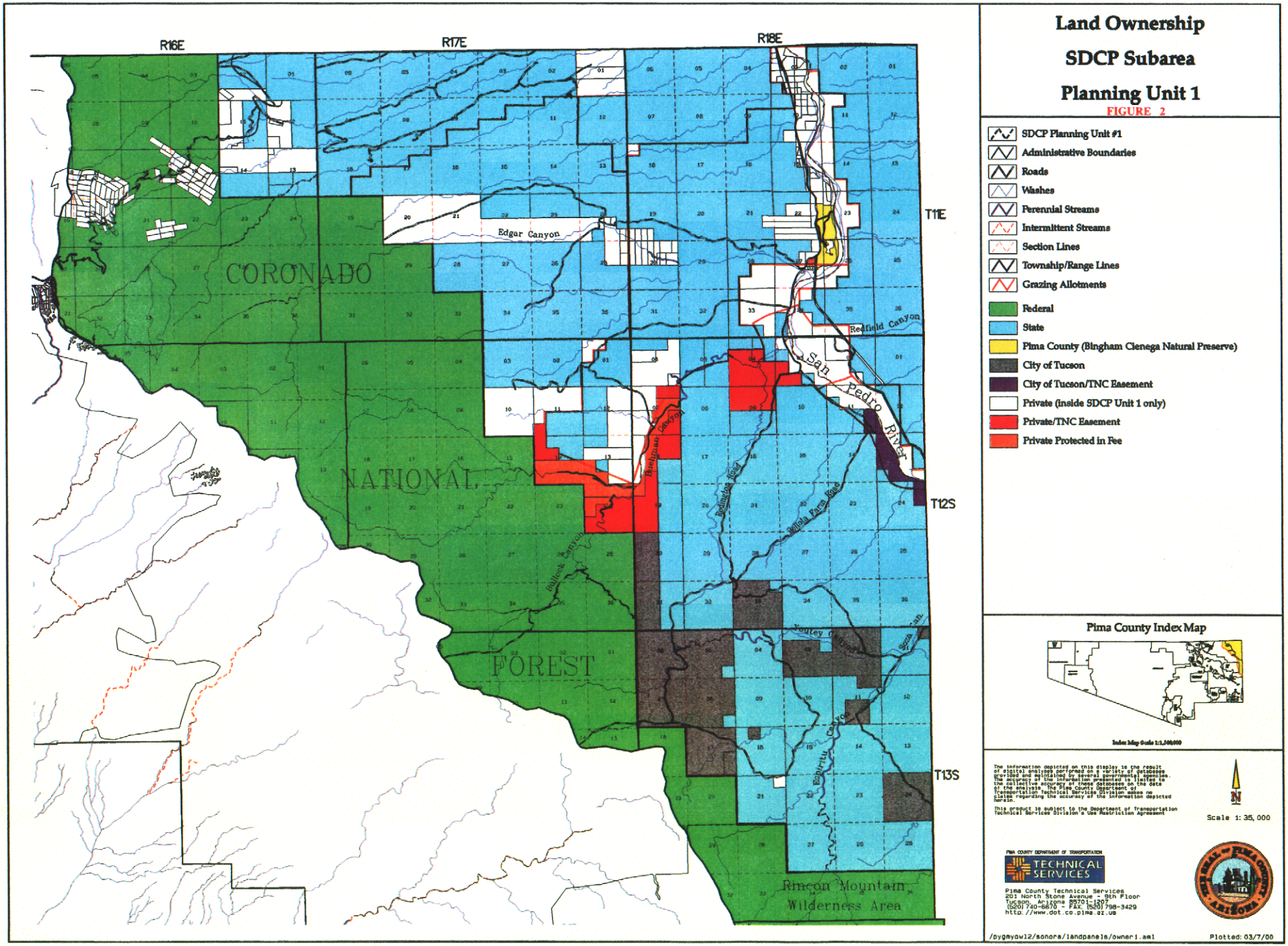
Private deeded parcels (13%) are scattered within a matrix of mostly public land (87%) (Figure 2). Most of the land immediately adjacent to the SPR is privately-owned, and upstream of the study area boundary but within the middle San Pedro Basin some land on the river is owned or under easements held by BLM.

State of Arizona trust lands are used to generate revenue for public education within AZ. They can be leased either for grazing, farming or commercial purposes. Leases can be assigned or sublet with approval of Arizona State Land Department Commissioner. Anyone can petition the ASLD to auction State trust lands to private buyers, but ASLD doesn't necessarily have to approve the auction request.

There appear to be three primary social networks in the middle basin, each overlapping with the others in membership – Redington NRCD, Cascabel Community Center, and Saguaro-Juniper Corporation. The NRCD is the most encompassing of the groups with respect to membership and communications. The NRCD functions as the local political subdivision and unit in the Middle San Pedro Basin. Cascabel Community Center is a limited social organization with the specific purpose of operating the Casacabel Community Center. Saguaro-Juniper Corporation interacts with many individuals within and outside the Cascabel community, including with an extended community in Tucson.

STAKEHOLDERS:

STAKEHOLDER	AFFECT ON CONSERVATION ACTIVITIES
Redington NRCD	· Implements conservation projects (e.g., Teran Wash stabilization) and looking to export results of these projects · Can solicit community input · Builds community support for conservation · Evaluates and approves proposals for Department of Agriculture conservation funds · Disseminates information on conservation practices
Riley West Inc.	· Donated much of Buehman Canyon to TNC
City of Tucson –A7 Ranch	· Encompasses the southern half of the subarea watershed · Contains 3 side canyons w/ reaches of perennial water, 2 possible occurrences of lowland leopard frogs, 2 possible occurrences of longfin dace, 2 occurrences of mixed decid. Broadleaf riparian forest, Pima Indian mallow (G2) · Proposes operation of grass bank on State Grazing Leases and deeded lands · Potential partner in implementing Best Management Ranching Practices in Middle San Pedro
AZ State Land Dept.	· Controls 34% or 91 sections of subarea · State trust land key to preserving unfragmented upland linkage between mountain ranges and between mountains and SPR. · Policies in transition -- re: non-use or conservation use, subleasing, auctioning to private buyer -- pending court cases and legislative review
The Nature Conservancy	· Owns Buehman Canyon Preserve · Holds conservation easements on Bellota Preservation Corporation lands · Holds conservation easement on City of Tucson Bellota Farm · Manages Bingham Cienega Natural Preserve for Pima County Flood Control District · Demonstrated ability to broker land acquisition and carry out natural area management and habitat restoration
Bellota Preservation Corporation	· Key private conservation land owner in Buehman Canyon Corridor. · Donated Conservation easement over lands in Buehman Canyon Corridor to TNC
Bayless & Berkelew Ranch	· Owns several miles of irrigated pastures and floodplain terraces, along SPR in subarea. · Possible cooperator in improving conservation management of river floodplain
Other private landowners	· Possible cooperators in improving conservation management of private lands in subarea · Possible substantial input into formulation of subarea conservation plan



Land Ownership
SDCP Subarea
Planning Unit 1

FIGURE 2

- SDCP Planning Unit #1
- Administrative Boundaries
- Roads
- Washes
- Perennial Streams
- Intermittent Streams
- Section Lines
- Township/Range Lines
- Grazing Allotments

- Federal
- State
- Pima County (Bingham Cienega Natural Preserve)
- City of Tucson
- City of Tucson/TNC Easement
- Private (inside SDCP Unit 1 only)
- Private/TNC Easement
- Private Protected in Fee

Pima County Index Map

Index Map Scale 1:1,500,000

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Scale 1: 35, 000

PIMA COUNTY DEPARTMENT OF TRANSPORTATION
TECHNICAL SERVICES

Pima County Technical Services
201 North Stone Avenue - 9th Floor
Tucson, Arizona 85701-1207
(520) 740-6670 - FAX (520) 798-3429
http://www.dot.co.pima.az.us

/pyg4yow12/sonora/landpanels/owner1.aml

Plotted: 03/7/00

STAKEHOLDER	AFFECT ON CONSERVATION ACTIVITIES
BLM	· Actively involved in SPR ecosystem protection project as owner/easement holder/manager of key riparian tracts and much of upper east side of watershed · Formal MOU with TNC for cooperative land acquisition and management in Cascabel area · Source of funding for fee and easement acquisition · Partner in cooperative management activities, including riparian and fire management · Manages mineral rights on all federal land, some state lands, and most private lands not adjacent to SPR
USFS	· Owns and manages 123 sections or 47 percent of subarea · Has given past approval to improved OHV access in Redington Pass area · Potential partner in preserving landscape connectivity & fire management · Opportunity to influence USFS management through upcoming revision of Coronado Nat. Forest management plan The new plan is due out no later than 2003.
USFWS	· Possible installation of fish barriers on SPR as result of Section 7 opinion on mitigation of impacts due to operation and maintenance of CAP canals. Most feasible location of barriers is in subarea · Responsibility for Federal T&E species recovery; potential source of conservation $$
Bureau of Reclamation	· Funding available for SW willow flycatcher management · Partner with USFWS on fish barrier project
NPS	· Manages 15 sections or 5.7 percent of subarea · Potential partner in preserving landscape connectivity
AZ Game & Fish Dept.	· Heritage Fund $$ for inventory, research, management projects · Potential partner in protection/management of wildlife linkage between mountains · Research and management assistance and consultation available from regional biologists
ADWR	· Funding for research and management for protection of rivers and riparian habitat through AZ Water Protection Fund grants · Administer instream flow process and water rights management
Pima County	· Future open space acquisition funding available for natural areas protection · Parks & Natural Preserves Map includes Bingham Cienega core area and part of Buehman - Redfield Canyon corridor · Parks and Recreation has MOU with Trust for Public Lands for TPL to assist with acquisition projects
Pima County Flood Control District	· Owner of Bingham Cienega · TNC has 25-yr management agreement with PCFCD to manage cienega

STAKEHOLDER	AFFECT ON CONSERVATION ACTIVITIES
Cochise County	· Improvement of road between Pomerene and Redington [Cochise County Highway Dept. [Willcox; 520-384-2182] has extended 5-year plan that calls for paving of 3 more miles of Cascabel Road in FY2002 (mileposts 8-11).
Great Western Trail Association and other OHV associations	· Lobbying for increased improvements/access for OHV use – could lead to wildlife disturbance and habitat degradation · Support for keeping Redington Road unpaved and `wild'
Mtn. Bikers association?	· Support for keeping Redington Road unpaved and `wild'
Keystone Minerals	· Mining in Buehman Canyon would likely degrade aquatic habitat and result in loss of fish and frogs, and change composition and quality of riparian community, severely impact wildlife corridor values
Cascabel Community Center	· Potential source of volunteers for conservation projects

CONSERVATION STRATEGIES THAT WOULD MEET BIOLOGICAL GOALS:

The overall biological goal in this subarea adopted by the Science Technical Advisory Team is to protect native plants, animals and natural communities of the Middle San Pedro River throughout Pima County by maintaining and/or restoring ecological and evolutionary processes that sustain them within a largely unfragmented landscape.

Strategies that would assist achieving this overarching goal include:

1. Identify, maintain, and/or restore key hydrological processes and watershed conditions that sustain perennial surface waters and riparian community dynamics of the Middle San Pedro River, its primary tributary canyons, and Bingham Cienega
   a. Increase existing baseflows, alluvial groundwater tables, and extent of perennial flow of the San Pedro River.
   b. Restore, to the degree possible and as predicted by appropriate models, natural river floodplain morphology and patch dynamics of cottonwood-willow, cattail-bulrush marsh, herbaceous wet meadow, and sacaton grassland-mesquite bosque floodplain terrace communities.
   c. Maintain or improve existing aquatic and riparian communities and improve watershed conditions in tributary canyons, with primary emphasis on Buehman, Paige, Youtcy, Soza Canyon and Espiritu canyons. These canyons are important in their own right and also because they form linkages with eastern basin drainages thus creating cross basin corridors.
   d. Protect water sources for Bingham Cienega and restore, to the degree possible and as supported by historical descriptions, natural vegetative community composition, structure, and distributional patterns.

2. Maintain existing populations of and protect and maintain habitats for globally rare species and, as appropriate, species listed as Federally or State threatened or endangered or listed in the Pima County Sonoran Desert Conservation Plan.

3. Maintain relatively unfragmented landscape connections between the Rincon, Santa Catalina, Galiuro and Winchester mountain ranges and through the San Pedro River valley that facilitate movement of wide-ranging wildlife species to meet seasonal and annual life requirements and for genetic interchange.
4. Build conservation partnerships among public agency partners, including ASLD, BLM, NRCS, USFS, NPS, and Cochise and Pima County governments, City of Tucson and strengthen the involvement of landowners and other residents in Middle San Pedro human community, including the Redington NRCD, in identifying and implementing shared conservation objectives and ecologically-compatible land uses.

Human settlement patterns would be driven by a land use ethic that allows the natural ecosystems to persist. Development would be sited to conform to patterns and processes described in ecological models for these systems. Agriculture would continue but in ways that do not lead to groundwater loss, riparian habitat loss, or degradation of watershed condition. While recreational use in this landscape would increase, OHMS would be confined mostly to Forest Service land in Remington Pass and largely outside of key wildlife movement zones. This vision of ecological conditions would transpire through collaborative efforts of landowners, other local citizens, local organizations, and public agencies. Local citizens' groups and organizations would develop the capacity to seize appropriate opportunities to acquire grants and implement conservation projects to conserve water, reduce soil erosion and other means to improve watershed condition, restore native riparian vegetation, and control non-native species, throughout the subarea.

These human decisions and concerns would result in positive outcomes for species of concern in the Sonoran Desert Conservation Plan. The river would sustain populations of at least two of the native fish species – longfin dace and desert sucker – and viable riparian communities. Beaver would have re-established, creating aquatic and riparian habitat diversity in a shifting mosaic of these communities. Tributary canyons would support viable aquatic and mixed broadleaf deciduous riparian forest communities. While present, non-native fish and plants would not displace native communities, but rather exist, at worst, as co-dominants. Wide-ranging animals (black bear, desert bighorn, mountain lion, bobcat, coati-mondi, Coue's white-tailed deer, mule deer, and possibly jaguar) would continue to move across the valley between the mountain ranges. Upland desert scrub, semi-desert grasslands, and oak-juniper would not be overgrazed, and natural fires would burn or be appropriately managed in these communities. The quality of these upland rangelands would be improving.

ECOLOGICAL CHARACTERIZATION OF TARGETS AND ECOLOGICAL PROCESSES:

In *Determining Vulnerable Species within Pima County, Arizona*, the Science Technical Advisory Team stated the goals and objectives of the biological element of the Sonoran Desert Conservation Plan, and identified over 100 vulnerable species occurring in Pima County. The report also presents species and habitats that are preliminarily recommended for protection under the conservation plan, many of which occur in the San Pedro subarea. The purpose of this report is to identify what is known about some of these species and the ecosystem processes that sustain them, as it pertains to the San Pedro subarea. Foremost are aquatic environments, wetlands, and riparian woodlands, which the Science Team considers "to be a high priority for conservation.... A large number of species listed within the report either live in aquatic or riparian habitats, or utilize them in some way. Primary threats include groundwater pumping, which has reduced water tables needed to sustain these ecosystems."

RIPARIAN AND AQUATIC COMMUNITIES OF THE SAN PEDRO RIVER AND ITS SIDE CANYONS, AND BINGHAM CIENEGA --

HYDROLOGY:

The San Pedro River consists of stretches of perennial flow (year-round), intermittent flow (seasonal), and ephemeral flow (only during storm events)(Figure 2). The perennial reaches are recharged by the alluvial aquifer and also serve to recharge that aquifer. Surface flows are the result of rainfall, runoff, and baseflow in perennial reaches. Groundwater reaches the middle San Pedro River as underflow from upstream and from mountain-front recharge via tributary canyons. Most precipitation input occurs during the winter and the summer monsoon season. Summer storms can represent 40-50% of the annual precipitation. Highest flows generally happen in August or September, but these are of short duration, generally lasting less than a day. Winter flows and floods are generally of longer duration than summer flows, especially during El Nino winter cycles, often lasting several days. Sustained winter or spring flows and alluvial and valley-fill groundwater recharge occurs because of runoff from melting mountain snowpack, especially in the higher mountains. It is the observation of those familiar with the system that the effects of rain and snow in the drainage is delayed anywhere from six months to two years.

Significant hydrogeologic features of the middle reach of the San Pedro River are at the Narrows (north of Tres Alamos Wash) and Remington, where bedrock formations force groundwater to the surface and effectively restrict underflow from and to adjacent sub-basins Figure 1;(T. Maddock, pers. comm.). Another geologic uplift causes a restriction in the vicinity of Bingham Cienega. Gaining reaches and sub-basin boundaries defined by basement igneous rock at or near surface at the Narrows, uplifted early Tertiary "Pantano"-like rocks with low porosity and permeability south of the Remington gage, and consolidated sedimentary rocks close to the surface adjacent to Bingham Cienega. The most significant losing reach of the middle San Pedro appears to be immediately downstream of the Narrows where a deep alluvial aquifer exists (T. Maddock, pers. comm.).

The height of the alluvial water table is controlled by several parameters during the year. Losses are due to evapotranspiration, stream flow, and pumping; gains are due to mountain front recharge, stream flow infiltration, and irrigation recharge. Mountain-front recharge is probably the most important source of valley-fill groundwater recharge in this sub-basin. Furthermore, the Rincons and Santa Catalinas probably provide greater recharge than the Galiuros due to their higher elevations and corresponding greater annual precipitation (T. Maddock, pers. comm.). Maddock (pers. comm.) believes that Paige Canyon and Hot Springs Wash provide the greatest input among the side canyons in this reach, but more work is necessary to confirm this. The side canyons have not been studied to help calibrate the water budget for the middle reach of the river.

In 1990, 3,770 acres were under irrigation between the gages at the Narrows and Remington (Jahnke 1994), and an estimated 8,583 acre-feet/year of water were used (consumptive use by plants) for irrigation in that reach (Lombard 1998). In the approximate 12 mile reach of river lying in Pima County there are approximately 1260 acres of terrace land that are irrigated. The Hydrographic Survey Report for the San Pedro River Watershed estimated that the maximum observed irrigation for these lands was 7,782 acre feet per year (volume pumped). Between the Narrows and the Northern Pima County line nearly 100% of water usage is for agriculture, and this water comes from either the shallow alluvial aquifer or diversion of surface flow. A water budget for the Remington subwatershed (Narrows to Mammoth) (ADWR 1991) for 1990 is presented in Appendix B.

Mean base flows from St. David to Remington have been significantly reduced since 1946 due to pumping for agriculture (Appendix C) (Jahnke 1994). Most of this reduction has taken place in the past 25 years. Total volume of groundwater pumping from Fairbank to Remington has gone from 2,500 acre-ft/yr in 1945 to nearly 35,000 acre-ft/yr in 1990. From 1945-1990, evapotranspiration declined to less than 50% of its earlier value, the result of the lowering water table and losses of riparian plant communities. Pumping was steady from 1946-1967, then increased in 1968, holding steady until about 1978, where it increased in a linear fashion until 1990 (Appendix D).

By 1990, north of the Narrows nearly 100% of pumpage was from floodplain aquifer. Average heads in the floodplain have dropped 4 ft. and mean baseflows have been significantly reduced.

Examining water elevations in wells, B. Richter (1990) found that well water elevations generally correspond to streamflow passing by the Remington stream gage, and this correlation holds in the reach between Teran Wash and Palomas Wash. However this correlation weakens with increasing distance upstream. Richter found that water table fluctuations, as demonstrated by well elevation data, were relatively small in reaches with perennial or nearly perennial flow. Fluctuations between minimum and maximum elevations were greater in ephemeral reaches. Richter (pers. comm.) surmises that the alluvial water table and baseflow should respond more rapidly and dramatically to cessation of groundwater pumping closest to the target reach. Therefore, cessation or reduction of agricultural pumping, the most intensive water use in this area, within and adjacent to the area between Remington Gage and the Pima County line should result in the greatest positive response in baseflow in this reach. However, additional hydrogeologic investigations should be undertaken to further understand the response of the hydrologic system.

J. Lombard (1998) performed a series of simulations using an upgraded version of Jahnke's 1994 MODFLOW model. These simulations tested the response to baseflow in the mainstem from retiring agricultural wells in various river segments. The results of the simulations show that retiring irrigation wells from the Narrows north to the

Remington gage (8,583 ac-ft/yr) has the most significant positive impact on mean annual baseflow in this reach of the San Pedro River.

The available empirical evidence and modeling information that deal with conditions in the river supports the following conclusions.

- Historically the river was perennial or intermittent through most of the central basin.
- The river is not perennial through most of the central basin at present and base surface flows have declined in the past 55 years
- Reduction in stream flows seems to be related to the escalating pumping of groundwater for cultural uses between 1945 and the present.
- Surface flows may be substantially improved through an adjustment in cultural use.
- A number of mechanisms exist that could lead to reduction of groundwater pumping.

WATER QUALITY:

ADEQ protected-use classification for this reach of the San Pedro River includes warm water fishery and wildlife, incidental human contact, agricultural irrigation, and agricultural livestock watering. Stream sampling done in June 1991 (Hughes property in Cascabel) indicated good water quality with low nitrate and ammonia values, a pH of 8.2, dissolved oxygen of 7.6, water temp. of 30.3° C, and discharge of 0.95 cfs. Although there were detectable concentrations of some metals, they were quite low. Groundwater samples taken at wells upstream and downstream of Cascabel and in some washes showed that highest water quality was in Paige and Hot Spring washes. Tributary washes appear to be sources of high quality groundwater to the San Pedro River (Riverside Technology 1992). Buehman Canyon was investigated and designated a unique water of the State by ADEQ in 1996. This designation provides for a high standard of protection of quality. As a tier one water there can be degradation of water quality due to a permitted human use.

ADEQ is presently conducting a ground water quality assessment of the entire lower basin of the San Pedro and this information will become available within the next year.

NATIVE FISHES:

Two species of native fish -- longfin dace (*Agosia chrysogaster*) and desert sucker (*Catostomus clarki*), four species of non-native fish -- black bullhead (*Ameriurus melas*), mosquitofish (*Gambusia affinis*), green sunfish (*Lepomis cyannellus*), and fathead minnow (*Pimephales promelas*) inhabit the perennial stretches of the San Pedro River in the Cascabel-Remington area. From 1991 to 1994, the longfin dace was by far the most abundant species found, with desert sucker second in abundance (Fall Fish Counts conducted by AZ Game and Fish Dept. for the Bureau of Reclamation). Over this four-year period, relative abundance of native to non-native fish decreased

from 100% to 82%. Mosquitofish increased in relative abundance from 0.8% (1992) to 14.7% (1994). No mosquitofish were collected in 1993, following the January flood, but were collected again in 1994. Black bullhead increased in relative abundance from 0.8% (1993) to 2.7% (1994). Green sunfish increased in relative abundance from 1.3% (1992) to 4.9% (1993). Fathead minnows increased in relative abundance from 0.8% (1992) to 4.9% (1993). Following the 1993 flood, native fish showed increased numbers, while exotics were either eliminated (e.g., mosquitofish) or unaffected.

Number of Fish Collected Near BLM-Hughes Ranch by Year

Species	1991	1992	1993 (winter flood)	1994	1995	1996	1997 (perennial reach had dried)
Longfin dace	161	367	204	152	1390	148	24
Desert sucker	0	0	14	0	2	0	0
Mosquitofish	0	3	0	27	422	22	4
Green sunfish	0	5	0	0	3	0	0
Fathead minnow	0	3	12	0	0	0	4
Black bullhead	0	0	2	5	1	1	7

Desert suckers live in flowing pools and behind boulders, logs, and other structures in rapids and runs (Smith 1966, Minckley 1969, 1973, 1981). Studies of desert sucker habitat and breeding are from higher gradient streams than the San Pedro River, where substrates are of predominantly larger grain size. For example, in Aravaipa Creek, optimal amounts of habitat are present at flows of 30-40 cfs (cubic feet/sec) for adult desert sucker and 20-30 cfs for fry and juveniles (Hardy et al 1990). In Sonoita Creek, Addley and Hardy (1995) recommended that optimal flows for sustaining both fry and adults is between 5 and 7 cfs. Lowe et al. (1967) showed that desert sucker had the lowest survivorship at reduced oxygen levels when sharing habitat with speckled dace, longfin dace, and desert pupfish. They use riffles or rapids for spawning and feeding (Minckley 1973). Specific habitat will vary by stream. Spawning generally occurs in late winter and early spring after winter floods before looser gravels become choked with finer sediments. Riffles with gravel, cobble and rubble substrates must be present for use as spawning areas. Fry and juveniles need adequate slow water nursery areas, e.g. pools and stream margins. Desert sucker feed on algae and organisms that they scrape from stones (Clarkson and Minckley 1988). Greater flows and habitat diversity, i.e., more riffles and runs, appear necessary to support desert sucker in the Cascabel reach of the San Pedro.

Longfin dace inhabit the perennial stretch of the San Pedro River. They also inhabit the perennial waters of Buehman Canyon, Bullock Canyon and Espiritu Canyon but are not known from the perennial spring fed stretch in Youtcy Canyon.

Longfin dace have been the most successful native fish when faced with a variety of introduced species, especially in areas of extreme conditions, i.e. low elevation, high temperature, shallow streams, in which longfin dace are best suited to survive. The

longfin dace is apparently the only native minnow that maintains high population numbers in the presence of the red shiner. Not only does flooding reduce populations of non-native fishes, periodic flooding may be used as a cue for breeding in the longfin dace.

Fish habitats are controlled primarily by sediment input and transport, which are functions of the volume and pattern of precipitation and runoff. A conceptual fish community model views baseflow, substrate composition, and habitat availability as ultimate controls on populations and community responses. High-gradient, narrow channels (e.g., side canyon aquatic habitats) receive coarser substrate, while finer sediments are deposited in areas where floodplains are wider and gradients lower (e.g., San Pedro River). Pools tend to be permanent only where large obstructions like boulders or trees exist. Pools are rare after a prolonged period of low discharge due to sediment filling; the streambed can become elevated, braided channels develop, and large-particle substrates are buried by fine sediments. A major flood event scours pools, thereby renewing the cycle. Native fish are generally better adapted to these flood cycles.

LOWLAND LEOPARD FROG (RANA YAVAPAIENSIS):

The core of the lowland leopard frog's range is in Arizona, and it is believed to be extirpated in California and New Mexico (Sredl 1997). Sonora is also within the species' range, but its status in Mexico is poorly known. Lowland leopard frogs are found in the San Pedro adjacent to Bingham Cienega and in Buehman, Bullock, Espritu and Youtcy Canyons. Lowland leopard frogs inhabit aquatic systems within desertscrub up to pinyon-juniper between 480 and 5960 ft (146-1817 m) elevation. At the higher elevations, this species may overlap with and is replaced by R. chiricahuaensis. However, in this area, R. chiricahuaensis has not been found west of the San Pedro River (Phil Rosen, pers. comm.). In Arizona, the lowland leopard frog is extirpated from the lower Gila and Colorado rivers (Sredl 1997). The species has declined fairly dramatically in southeastern Arizona, but its status in Arizona is stable as central Arizona populations appear to be doing well (Sredl 1997).

According to Sredl (pers. comm.), a viable population or metapopulation of lowland leopard frogs would have the following characteristics: 1) a diversity of pool habitats and healthy riparian cover in one or preferably several adjacent canyon systems, 2) stable numbers of adult frogs over many years at the same sites, 3) regular or frequent evidence of recruitment, 4) lack of non-native predators (e.g., bullfrogs, crayfish) in the watershed, and 5) relatively good watershed condition (i.e., no severe sedimentation problems). Based on current knowledge, the Cascabel `site' appears to have all of these characteristics, though more assessment of individual canyon populations is necessary to confirm this. In Sredl's experience, he believes that Buehman Canyon supports a stable population of this species. Frogs have also been found in Bullock Canyon, a tributary to Buehman and Jim Malusa reported leopard frogs from Espiritu

and Youtcy Canyons in his 1990 survey of the area. Chris Fichtel (pers. comm.) of The Nature Conservancy visited Espiritu and Youtcy Canyons in 1998 but did not record frogs in these locations. Rosen (pers. comm.) reported that all perennial reaches from the Narrows to Dudleyville contain lowland leopard frogs and often in abundance. He strongly supports the conservation approach of protecting the side canyons as a means of protecting metapopulations of lowland leopard frogs.

Anthropogenic factors implicated in declines of amphibians include: 1) Non-native predators and competitors, such as bullfrogs, bass, green sunfish, and possibly crayfish., 2) lowered pH due to causes like acid rain or leachate from mine tailings, 3) toxic levels of heavy metals leached from mine tailings or due to acidic precipitation, 4) destruction or degradation of habitat, and 5) pumping groundwater at springs where frogs occur.

Patches of aquatic habitat connected by drainages that can be traveled by dispersing leopard frogs, at least intermittently, should form the foundation for a functioning metapopulation (Sredl 1997). Unfortunately, dispersal capability of leopard frogs, especially upstream to upper canyons, is unknown This information is necessary to identify characteristics of dispersal corridors that facilitate maintenance of functioning metapopulations.

RIPARIAN BIRDS:

More than 100 species of birds were recorded on BLM properties in the Cascabel area (BLM 1995) upstream of the Pima County reach of the river. Of the 100 species, 68 are considered possible, probable, or confirmed breeding species, and at least 34 species are considered riparian obligates. Rare or declining species of riparian-nesting species include: northern gray hawk, zone-tailed hawk, common black hawk, Mississippi kite, cactus ferruginous pygmy-owl, western yellow-billed cuckoo, southwestern willow flycatcher, and northern beardless-tyrannulet. See appendix E for lists of birds recorded in riparian areas of the subarea.

Northern gray hawks nesting density was considered particularly high on the BLM-Hughes tract; the 4 to 5 pairs nesting in the two parcels constitute about 5% of the total U.S. population. In Arizona this species is known to nest almost exclusively in tall cottonwoods adjacent to extensive areas of mesquite and prefers stringers of cottonwoods, not single trees (Glinski,1986). The Cascabel area has extensive mesquite bosques but only a few areas where there are stringers of tall cottonwoods. Nesting conditions in the Pima County reach of the San Pedro River are poor and gray hawk nesting is unknown in this reach.

There is only one confirmed nesting occurrence of the zone-tailed hawk from riparian forest along the SPR in the Cascabel area. Other records come from mixed deciduous broadleaf riparian forest in side canyons. Zone-tailed hawk has been observed nesting

in Buehman Canyon on The Nature Conservancy preserve each year since they acquired it in 1996.

Habitat for the western yellow-billed cuckoo exists in this reach of the San Pedro River valley, but only one nesting occurrence is documented. This species prefers dense riparian thickets in the Southwest.

The southwestern willow flycatcher has been found at Bingham Cienega on one occasion and only one singing male, but nesting was not confirmed. This species prefers dense, even-aged stands of willow, seepwillow, saltcedar, or arrowweed typically 13-23 feet tall with a scattered overstory of cottonwood.

Cactus ferruginous pygmy-owls have not been found in this area, though suitable mesquite bosque habitat exists.

FREMONT COTTONWOOD - WILLOW RIPARIAN FOREST

Ecological descriptions and models for this riparian community are taken from Gori (1996) and Stromberg (1998 - in press).

According to historic accounts, pre-settlement, low-elevation, arid land rivers, such as the San Pedro, had the following characteristics: multiple, meandering channels with low or sloping banks; high water table with shallow water spreading out over much of the floodplain; point bars at channel meander bends; cienegas dominated by wetland herbaceous plants with extensive deposits of peat; numerous beaver-impounded stream segments; a diversity of cottonwood and willow cohorts along edges of active channels and meander scrolls; wide meadows of sacaton adjacent to stands of cottonwood and willow; and open stands of mesquite, hackberry, ash and walnut with understories of upland perennial grasses and sacaton forming an ecotone to the adjoining uplands. On point bars and terraces formed by constantly shifting channels, cottonwoods and willows would thrive. As the terraces aggraded, cottonwoods would mature, and over time would be replaced on these higher floodplain terraces by mesquite and other riparian tree species which can survive higher above the groundwater table.

During the late 1800's and early 1900's removal of native vegetative cover, especially grasses, due to overstocking of livestock denuded uplands, thus permitting more rapid storm runoff to the floodplain. Combined with substantial floods and loss of beaver, stream channels rapidly downcut. The entrenched floodplain, rapid runoff of stream flow, drought, and increased groundwater pumping all contributed to declining groundwater levels. More rapid runoff also increased the scouring effect of high-velocity flows which removed seedling riparian trees and caused further entrenchment.

Former floodplain terraces with sacaton and mesquite grew increasingly farther from groundwater. Sacaton, which does best with a shallow water table and occasional fire, declined in importance with declining water levels, decreased fire frequency, and encroachment of exotics. In these situations, mesquite is favored because: 1) it is able to survive better because it has a deeper root system, 2) livestock feeding on mesquite beans increase the prevalence of the species on the terraces, and 3) reduced incidence of fire coupled with intense livestock grazing would eventually allow terraces to succeed to a mesquite-dominated community. Overgrazing of sacaton meadows and mesquite woodlands reduced cover of sacaton and other native perennial grasses, presumably facilitating rapid invasion of these areas by the non-native grass such as red brome.

D. Gori (1996) presents a patch successional model for cottonwood-willow and sacaton/mesquite bosque riparian communities (Appendix F) that was originally developed by Richter and Richter (1992). The model starts with a large (^{3} 25 year return interval) flood that reworks the floodplain, producing extensive low terraces on either side of the channel for cottonwood, willow, and seepwillow germination (streamside/herbaceous-strand). The stream abandons its primary channel in many places and realigns to new locations as meanders move laterally and downstream. After large floods, the patches begin or resume the successional pathways shown in Appendix F.

Cottonwood, willow, and seepwillow seedlings will become saplings in the next growing season in non-inundated portions of the streamside herbaceous/strand providing no floods $\geq$ a 2-year return interval flood occur during this period.

SACATON GRASSLAND/MESQUITE BOSQUE:

The cottonwood-willow pole stand will develop into a mature cottonwood-willow stand in the absence of a $\geq$ 25 year return interval flood; if such a flood does occur, the transition may still proceed providing a channel realignment that moves the channel away from the pole stand also occurs. The mature cottonwood-willow stand will develop into mesquite bosque as cottonwoods and willows ages, topple over, and are replaced by mesquite which has germinated and grown in the understory of these trees.

Sacaton grassland is an ecological equivalent of mesquite bosque occurring on higher, older floodplain terraces and developing successionally from mature cottonwood-willow forest. At lower elevations, sacaton grassland is favored and will develop when wildfires are frequent since mortality of young mesquites is high with frequent fires (Appendix G). With no or infrequent fires, mesquite bosque will develop; no fires favor dense, closed canopy bosques while infrequent fires, at least historically, favored open, park-like bosques. However, because of the increased fuels in extant bosques (due to the dominance of exotic annual grasses in the understory and woody fuel buildup due to 100-years of fire suppression), intense fires now result in the

replacement of mesquite bosque by exotic annual grassland. In the absence of further fires, if water tables are high, mesquite bosque will become reestablished via seedling recruitment and resprouting by surviving mesquite. The survivorship of mesquite will be a function of fire intensity and depth to groundwater which affects plant vigor. If water tables are low and most mesquites succumb to fire, Sonoran desert scrub or semi-desert grassland may result.

Stromberg et al. (in press) adopted a quantitative approach for the upper San Pedro, dividing vegetation into 4 groundwater zones (Appendix H) and modelling the change in areal extent of the different zones under 3 groundwater pumping scenarios. When groundwater depth declined by $\geq$ 0.3 m (1 ft)obligate and facultative wetland species in Zone 1 declined sharply. When groundwater depth declined by $\geq$ 1 m (3.3 ft), Zone 1 plants were extirpated and the distribution of Zone 2 species was significantly restricted. At the same time cover by Zone 4 species increased. Juvenile willows (obligate wetland) and cottonwoods (facultative wetland) were the most sensitive indicators among the woody Zone 2 plants. Juveniles of these tree species grew along the San Pedro River where groundwater depths ranged from 0 to 2 m (6.5 ft). Other studies have shown that seedlings of these and related species survive only where depth to groundwater is less than 1 m, and that they can tolerate daily groundwater declines of no more than a few centimeters per day (Stromberg et al. 1991, Mahoney and Rood 1992, Segelquist et al. 1993).

In the perennial reach of the San Pedro River at Cascabel, cottonwoods have been increasing in abundance relative to saltcedar from the 1960s to the present, and in the 1990s were significantly more important than saltcedar for the first time since the 1920s (Stromberg, in press), before saltcedar began to invade floodplain areas in the 1950s. The 1990 decadel cottonwood cohorts had higher density and occupied more floodplain area than any other decadel cohort or saltcedar. Most cottonwoods and saltcedars along this reach of the San Pedro River date to years of winter floods from 1960 to the present. Since 1960, climatic fluctuations linked to El Nino-Southern Oscillation weather patterns created a series of winter flood flows that has been more favorable to riparian tree establishment (Stromberg, in press). Over the past 36 years, winter floods have been more frequent and cottonwoods have established, on average, about every 5 years. Removal of livestock in some riparian areas in this area may have given the highly palatable cottonwood and willow greater likelihood of survival past the seedling stage and shifted the competitive balance to favor cottonwood-willow over saltcedar.

Saltcedar dominates at the ephemeral sites where groundwater is deeper, such as where groundwater declines have occurred. Saltcedar is known to have deeper roots, higher water use efficiency, and greater capacity for utilizing water from unsaturated soils than Fremont cottonwood (Stromberg, in press). It is also able to survive better in soils with high salinity. Increase in salinity in the lower San Pedro River basin may be due in part to accumulation of salts from irrigated agricultural fields (Stromberg, in press), although data from other San Pedro studies are not consistent with this.

Flushing of lower floodplain soils during high-flow events may reduce salt content of these soils, but saltcedar itself can increase salinity levels. Within multi-species patches of seedlings, livestock prefer the more palatable cottonwoods and willows over saltcedar, thus favoring saltcedar by reducing competition from faster growing willows and cottonwoods (Stromberg, in press). Therefore, persistence or enhancement of existing perennial flow conditions could flush floodplain soils thereby maintaining adequate conductivity values for cottonwoods and willows.

Conditions through much of the Pima County reach of the San Pedro are such that salt cedar is favored and cottonwood-willow riparian forest is limited Figure 3. Part of this limitation may relate to suppression of recruitment by cattle as well as by inhospitable hydrologic conditions.

Mesquite bosques along the middle reach of the San Pedro are dense stands, and in nearly all cases, the ground is carpeted with the exotic annual grasses, red brome and foxtail, or other exotic species. Given present elevations above the floodplain, some of the existing bosques might become senescent and succeed to some upland scrub association unless groundwater elevations increase. Presence of livestock and feral hogs can perpetuate thick stands as mesquite beans are a preferred food when available. Fuel buildup in these stands (grasses and mesquite limbs) could lead to intense fires able to kill or top kill mesquite and kill cottonwood and willow in the nearby floodplain. Fire can eliminate or seriously reduce cottonwood-willow nesting habitat for riparian birds, such as the southwestern willow flycatcher. In these situations, saltcedar could be favored due to its tolerance to fire.

The key stresses and sources of stresses that affect the maintenance of the cottonwood-willow-mesquite bosque/sacaton grassland riparian system in this section of the San Pedro River include:

1) declining surface flows and increasing groundwater depths from pumping
2) loss of bank storage and lateral movement of water due to absence of beaver
3) exotic species, especially saltcedar, Bermuda grass, and red brome
4) livestock grazing in cottonwood-willow
5) OHV use in the river channel which disrupts nursery bars of cottonwood and willow seedlings
6) fire in mesquite bosques that could kill mesquites and cottonwood-willow in adjoining floodplains (however, fire is important for maintenance of sacaton grassland and mesquite-sacaton savannah systems)
7) reduction in sediment deposition due to surface flow diversion
8) increased salinity due to irrigation and presence of saltcedar [salinity in groves of saltcedar may disrupt successional pathway to mesquite bosque]

According to J. Stromberg (pers. comm.), a better perspective on historic vegetative and hydrologic conditions is necessary to understand the presettlement distribution of cottonwood-willow in the Cascabel-Remington reach of the San Pedro River.

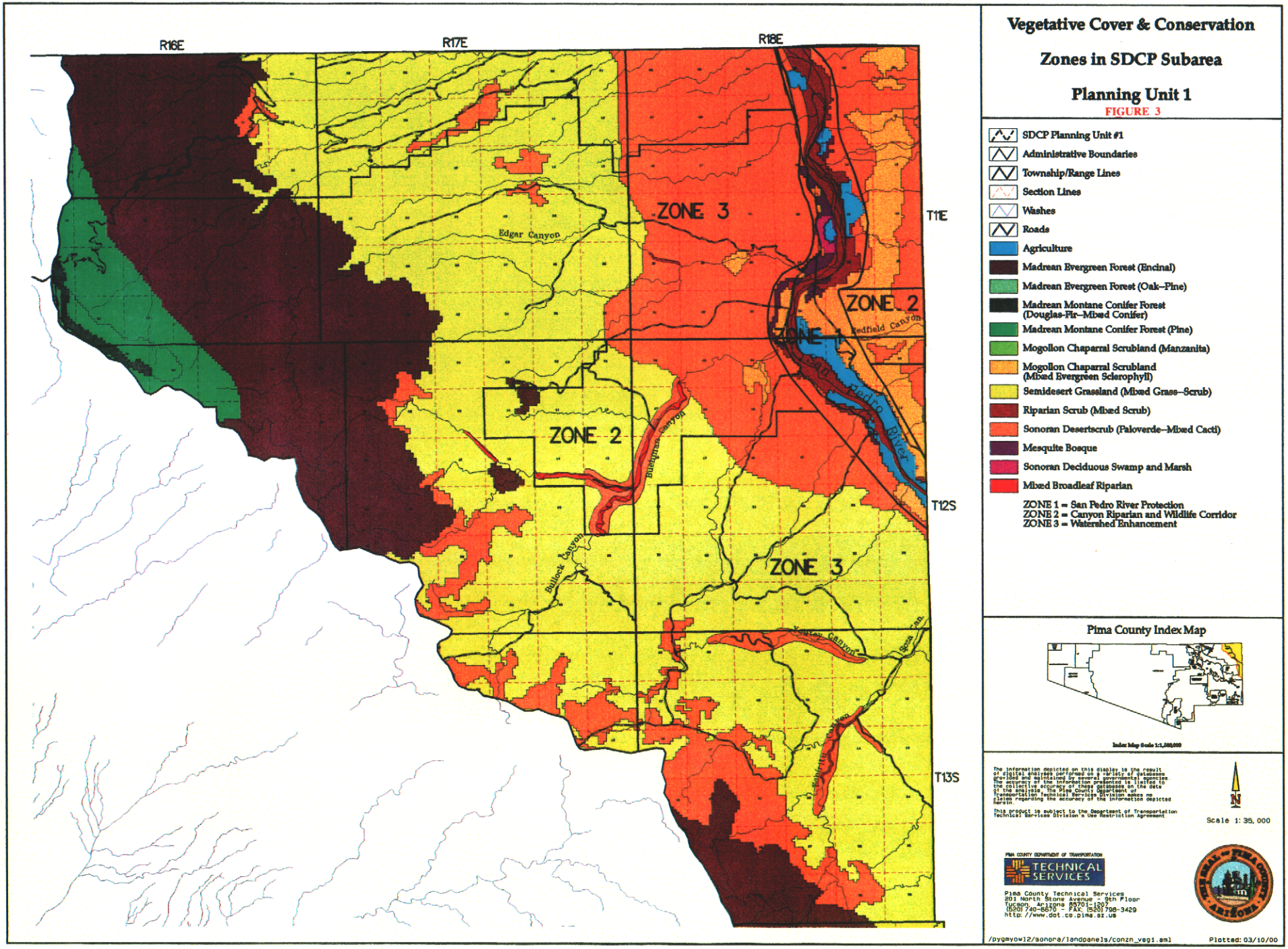
Examination of early explorers' surveys, General Land Office survey records, and early and middle 20th century descriptions of the floodplain, and long-term groundwater (well) records could form the basis for a historic groundwater-vegetation model.

SONORAN CIENEGA WETLAND AND WOODED SWAMP (BINGHAM CIENEGA):

Bingham Cienega is a wetland complex made up of cienega marsh, willow-velvet ash-buttonbush swamp, mesquite-hackberry woodland, and restored sacaton grassland. Some wetlands widely recognized as cienegas (e.g. Bingham Cienega) are actually lotic systems that support extensive stands of cattails and bulrushes. Cienegas are generally high in habitat diversity, thus supporting high wildlife diversity. Bingham Cienega is presently isolated from direct river flows and functions as a spring-fed system. The primary conservation goal at Bingham Cienega is to maintain a natural hydrological regime and to restore natural patterns of habitat and wildlife diversity. Juxtaposition of habitat patches and species composition for this site are not known because the historic record is poor, but information from other cienegas and descriptions from General Land Office survey records provide some indication of expected or desired conditions. Desired conditions call for maintaining the saturated herbaceous zone (cattail-bulrush), and restoring various vegetation zones progressively east toward the river – mixed deciduous broadleaf riparian forest, herbaceous wet meadow, sacaton grassland, and mesquite-hackberry woodland with native grama and other grasses.

The most important ecological parameter in formation and maintenance of a cienega system is hydrology. Fire and sediment transport are also factors. Restoration of the natural pattern of vegetation of the cienega and the wetland/upland ecotone will depend to a significant degree on the hydrological conditions of the system. We need to answer the question, "What hydrological conditions are necessary in order to maintain the desired composition, structure, and distribution of vegetation in the cienega?".

This cienega can be modeled as a system driven primarily by water, and secondarily by fire and sediment transport. Isotopic studies of basin hydrology (Phillips et al. 1993) and vegetation and hydrologic analyses (Baird et al. 1997) indicate that inflow to the cienega complex includes underflow from San Pedro River floodplain alluvium and underflow from Edgar, Buehman, and Redfield canyons originating as mountain-front recharge. The steady-state water budget for the cienega (Baird et al. 1997) estimates mountain-front recharge, stream leakage from both gaining and losing reaches of the river, and underflow in order of importance. T. Maddock (pers. comm.) believes that the major limiting source of water to Bingham Cienega is the river itself. Outflow from the system is stream leakage to the floodplain aquifer, evapotranspiration (ET), spring flow, and underflow. Stream leakage, ET, and underflow are modeled as equally significant outflows from the system, with spring discharge as a minor component. Another outflow from the system could be groundwater pumping upstream from the site as this will affect baseflows and the



Vegetative Cover & Conservation Zones in SDCP Subarea Planning Unit 1

FIGURE 3

- SDCP Planning Unit #1
- Administrative Boundaries
- Township/Range Lines
- Section Lines
- Washes
- Roads
- Agriculture
- Madrean Evergreen Forest (Encinal)
- Madrean Evergreen Forest (Oak–Pine)
- Madrean Montane Conifer Forest (Douglas-Fir–Mixed Conifer)
- Madrean Montane Conifer Forest (Pine)
- Mogollon Chaparral Scrubland (Manzanita)
- Mogollon Chaparral Scrubland (Mixed Evergreen Sclerophyll)
- Semidesert Grassland (Mixed Grass–Scrub)
- Riparian Scrub (Mixed Scrub)
- Sonoran Desertscrub (Paloverde–Mixed Cacti)
- Mesquite Bosque
- Sonoran Deciduous Swamp and Marsh
- Mixed Broadleaf Riparian

ZONE 1 = San Pedro River Protection
ZONE 2 = Canyon Riparian and Wildlife Corridor
ZONE 3 = Watershed Enhancement

Pima County Index Map

Index Map Scale 1:1,500,000

Scale 1: 35,000

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/pygmyowl2/sonora/landpanels/conzn_veg1.aml

Plotted: 03/10/00

groundwater depths in the floodplain aquifer. Inflow and outflow should equal the values presented in the model of Baird et al. (1997) for the system to be maintained. Groundwater pumping and surface water diversion are the human-induced stresses to this hydrological system.

Appendix I indicates water depths necessary to support various cienega plant communities. This figure is based on current measurements of water depth. Presumably any significant long-term decline in the water table will cause shifts in species distribution, possibly eliminating certain vegetative zones. However, while water depths explain some of the variance in species cover (for example, mean annual water depth explained 32% of the cover variance for Typha, and only 19% for Scirpus), other untested variables appear to exert considerable influence over plant species distribution. Monitoring wells in place across the water depth gradient of this system will allow us to track changes in the water table, but vegetative changes could take place independent of changes in water depth. Other variables that likely affect plant species distribution include: distribution of exotic species, site disturbance history (including fire), and the random preemption of one native species over another (especially those species with similar environmental requirements).

In addition to hydrologic conditions, past land use and introduction of exotic plant species also play a role in the distribution of native plant communities. For example, dense mats of Bermuda grass occur adjacent to the typha-scirpus marsh. These occur in the previously cultivated agricultural fields and after two years of data gathering in conjunction with a sacaton restoration project the evidence is mounting that Bermuda suppresses recruitment and growth rates of native species such as mesquite and sacaton. Another exotic common to the abandoned agricultural fields is Johnson grass. Both Johnson grass and Bermuda have the capability to expand very rapidly and to outcompete reintroduced natives. To combat this The Nature Conservancy is carrying out a restoration project funded by Arizona Water Protection Fund, U.S. Fish and Wildlife Service, Pima County Flood Control District and private sources. The project is designed to reestablish giant sacaton, mesquite woodland and wooded swamp on approximately fifty acres of abandoned agricultural fields.

MIXED BROADLEAF DECIDUOUS RIPARIAN FOREST

In the Middle San Pedro Subarea mixed broadleaf riparian forests are found in Edgar Canyon, Buehman Canyon and Bullock Canyon (Figure 3). Youtcy Canyon and Espiritu Canyon also support very limited riparian forest species and these are not extensive and may not be considered a true riparian forest. It is possible that the quality of these habitats might be improved with the livestock management proposed by the City of Tucson as part of their grass bank management on the A7 ranch (formerly Bellota Ranch). The highest quality and most extensive mixed broadleaf forest occurs in the Buehman-Bullock Canyon system. Edgar Canyon is the next best mixed broadleaf forest in the study area. It is possible that the quality of the Edgar Canyon forest

could be improved with a management approach directed toward habitat conditions.

Mixed broadleaf deciduous riparian forests occur along intermittent and perennial montane streams in the Southwest, between 1000 and 1700 m (Stromberg et al. 1996). These forests typically occur in cooler, higher gradient, and more rocky canyon bottoms than cottonwood-willow and its associated low-gradient riparian communities. This riparian community contains a great diversity of tree species, including velvet ash (*Fraxinus pennsylvanica* var. *velutina*), Arizona sycamore (*Platanus wrightii*), Arizona walnut (*Juglans major*), netleaf hackberry, (*Celtis reticulata*), as well as Fremont cottonwood, Gooddings willow and Bonpland's willow. Ash and sycamore are usually dominant in this community type. However, variations in stream gradient, stream power, valley width and elevation contribute to differences in canopy dominants between streams and along gradients of the same stream system. Amount and variation in stream flow rate and groundwater depth also influence plant composition (Stromberg et al. 1996). Stromberg et al. (1996) concede that much remains to be learned about the ecological processes and conditions that allow for establishment and persistence of mixed broadleaf deciduous riparian forests.

Winter floods appear to be important for seedling establishment of Arizona sycamore. In a study in Garden Canyon in the Huachuca Mountains, Stromberg et al. (1996) found that sycamore showed pulses of establishment during periods of large winter storms. Ample water during spring is essential for Arizona sycamore seedling establishment. Sycamore seems to be most abundant in low-gradient, valley-fill areas of canyon bottoms (Stromberg et al. 1996). Stromberg et al. (1996) suggest that shallow groundwater may serve as the primary water source for this species in ephemeral and possibly perennial stream reaches.

Velvet ash and Arizona walnut both have a large ecological range, and grow along banks, terraces, and slopes of ephemeral, intermittent, and perennial streams (Stromberg et al. 1996). Arizona walnut shows more recruitment on sites such as banks of intermittent streams. Establishment of seedlings is associated with a series of wet years that result in abundant moisture (Stromberg et al. 1996). Fire may aid recruitment of walnut, as fire may serve to reduce competition from dense herbaceous cover (Stromberg and Patten 1990).

BEAVER:

Beaver strongly influence stream and floodplain systems. Beaver dams serve to slow surface water flows, slow or reverse stream channel entrenchment, spread surface and, presumably, subsurface, water laterally within the floodplain (increasing bank storage), cause local increases in groundwater tables, and increase riparian habitat diversity. M. Pruss (AGFD, pers. comm.) recommends a minimum of 0.5 miles of suitable habitat along the San Pedro River to support one beaver family. Suitable habitat consists of a diversity of age classes of cottonwood and willow up to 9 in dbh,

with a preponderance of stems less than that (around 3 in dbh). These will be used primarily for food. They will use other woody material, as well as cottonwood-willow, for dam construction. They might be expected to utilize a bank lodge, and may pile sticks around the bank entrance. Materials for the dam might include saltcedar, mesquite, and any downed woody material in the floodplain. If AGFD initiates a project to restore beaver to this reach, they will need to conduct a formal habitat assessment, which will follow guidelines for beaver habitat in the USFWS HSI model for beaver. They will also need to scope out the public's concerns about beaver restoration. Another primary consideration should be the potential increases in numbers of bullfrogs and non-native fishes with increased amounts of pool and other slow-water habitats behind beaver dams.

Beaver historically created a hydrologic environment conducive to cienega formation. Restoration of beaver to Bingham Cienega should be a long-term management strategy pending successful restoration of beaver to the upper San Pedro River. It is also possible that beaver may naturally return to the Lower San Pedro River. They were once extremely common in the system and they are common on the Gila River near the confluence of the San Pedro. In past years there have been several reports of beaver moving upstream along the river and temporarily occupying habitat at various points as far south as Cascabel. Some ecologists believe that beaver have not expanded back into the San Pedro system because of continued human pressure to eliminate them when they attempt to establish populations. It may be that a valuable strategy to support natural colonization by beaver will relate to reducing human pressure against their return.

LANDSCAPE CONNECTIVITY BETWEEN MOUNTAIN RANGES:

The Middle San Pedro Subarea encompasses the western portion of several wildlife/openspace corridors connecting the Rincon and Santa Catalina Mountains to the Galiuro Winchester Mountains. These corridors can in part be defined by canyon pairs that exist across the landscape. For example, Buehman Canyon and Redfield Canyon; Paige Canyon and Hot Springs Canyon; Soza Canyon and Soza Wash are all pairs of large drainages that provide travel corridors for various wildlife species across the basin.

Within the San Pedro River watershed, the middle basin landscape provides a practical opportunity to create protected connections between Sky Island mountain ranges that includes high elevation forest systems and diverse tributary canyons. Furthermore, these landscape connections provide linkage in a more extensive integral landscape that connects mountains, grasslands, and desert between the White Mountains and Mexico. Just as important a corridor is the mainstem and riparian zone of the San Pedro River for movement of birds, mammals, amphibians, reptiles, and some invertebrates.

Dr. David Gori (October 1997) discussed wildlife corridors in conjunction with The Nature Conservancy's assessment of acquisition of the Bellota Ranch as follows. "The primary ecological value of the [Bellota] ranch may be in its function as a wildlife corridor, linking up large mammal populations in the Galiuro, Santa Catalina and Rincon mountains. Mammals which may benefit from such a corridor include black bear, mountain lion, jaguar, Coue's white-tailed deer (primarily a higher-elevation species that is displaced by desert mule deer at lower elevations), and desert bighorn. Forest birds (Mexican spotted owl) may also benefit as several studies have shown increased immigration rates to habitat patches when corridors are present (Dunning et al 1995, Haas 1995, Saunders and de Rebeira 1991, Machtans et al 1996). The property can function as a corridor (or part of a corridor) in several ways: (1) it can connect higher elevation habitats in the Rincons, Catalinas, and Galiuros and reduce extinction rates from these habitats, increase recolonization rates after local extinction, and permit gene flow between habitats; (2) it can allow an interchange of wildlife between different habitats (e.g., Sonoran desert to desert grassland to juniper-pak savannah, etc.); (3) it can allow wildlife to migrate seasonally (e.g., elevational migration in birds, coyotes, bears, desert bighorn); and (4) permit species to change environments in response to environmental change (e.g., global warming).".

To date, there have been only a handful of good studies on corridors, but they clearly show either that corridors increase population viability or habitat occupancy (MacClintock et al 1977, Mansergh and Scotts 1989) or that animals use corridors to move between habitat patches (and often will not move through the non-corridor matrix) [mountain lions (Beier 1995); wolf, lynx, and cougar (Heuer 1995); elephants (Jonsigh et al 1990); arboreal marsupials (Lindenmayer et al 1993); deer, bobcat, and cougar (Mock et al 1992); woodland butterflies (Sutcliffe and Thomas 1996); ocelot (Tewes 1994); forest birds (Machtans et al. 1996), jaguars (B. Davis, pers. comm.)]. We clearly need more information on corridor use by other species, the types of habitats that function best as movement corridors, and on species-to-species differences in corridor requirements (e.g., size, width, vegetation type, etc.).

Desert bighorn will use open, exposed habitat for moving across the landscape (R. Olding, AGFD, pers. comm.). Ough and deVos (1984) stated that primary intermountain travel corridors for desert bighorn sheep were routes with minimum distances between mountains through low hills covered by creosotebush-ocotillo and paloverde-saguaro associations. These associations provide little cover for predators. Additionally, rocky terrain provides escape cover for sheep (Ough and deVos 1984). Water catchments near travel corridors may enhance their use. Witham and Smith (1979) suggested that when ewe associations become isolated there is a greater likelihood of inbreeding, but that widespread movement of rams could counteract this. Bristow et al. (1996) reported that intermountain movements of bighorns around the Silverbell Mts. were made exclusively by rams. At least two rams moved between the Santa Catalina and Galiuro Mtns. during tracking studies of transplanted sheep; their movements were through open, rocky habitat near Buehman Canyon and through the Remington Pass area (R. Olding, AGFD, pers. comm.).

Intermountain movement of black bears is not uncommon; they prefer to move along canyon bottoms that are vegetated with mixed deciduous broadleaf riparian forest (R. Olding, AGFD, pers. comm.). Based on his knowledge and descriptions of riparian habitat along the San Pedro River and the side canyons, Olding (pers. comm.) surmised that bears will probably use Buehman, Soza, and Paige canyons.

P. Beier (pers. comm.) felt that focusing on preserving canyons intact is important to preserve mountain lion (*Felis concolor*) travel corridors, as they will most likely use canyon bottoms. Creek and canyon bottoms tend to be natural travel corridors between mountain ranges for mountain lions in southern California (Beier 1993). In Aravaipa Canyon and the north end of the Galiuros, where lions are hunted for predator control, immigration by young mountain lions appears to be necessary to sustain the resident lion population (Cunningham et al. 1995).

Canyon bottoms with riparian forest are likely to be preferred movement habitat for bobcats (*Felis rufus*). Boyle and Fendley (1987) mentioned that in the West, riparian areas are preferred habitat for bobcats, and that they frequent washes, stream bottoms and rocky cliffs in central Arizona (Lawhead 1984).

Coati (*Nasua narica*) in southern Arizona, though found in a variety of habitats, appear to concentrate their activities in or near riparian areas, primarily in areas where the riparian community extends into the desert (Risser 1963). R. Olding (pers. comm.) also believes that coatimundis prefer canyon bottoms for their movements between mountain ranges. Troops of coati-mondi have been regularly observed using Buehman Canyon.

Desert mule deer use riparian areas for forage, cover, travel lanes, and birth sites. In central Arizona, deer use washes 42% of the time, while in the summer, use increases to 83% (Krausman 1998).

R. Olding (AGFD, pers. comm.) believes that present types and levels of human recreation in the Remington Pass area are not sufficient to impede wildlife movements to and from the mountain ranges. Most motorized recreation is restricted to roads and trails in the immediate vicinity of the Pass. Human recreation in the Santa Catalinas is still concentrated within 0.5 miles of the Catalina Highway and most hiking trails are on the Tucson side of the mountains (R. Olding, AGFD, pers. comm.).

RARE PLANTS:

PIMA INDIAN MALLOW (ABUTILON PARISHII):

There are two documented sites for Pima Indian mallow within the subarea, both between 3,000 and 4,000 ft elevation. This perennial species is known to occur only in central and southern Arizona and Sonora. Habitat is bouldery, shallow soil in open locations and very steep canyon slopes in higher elevation Sonoran desertscrub.

Populations appear to increase in wet years and decline in dry years (Van Devender et al. 1994). Flowering can occur spring through fall, in response to rainfall, but flowers open only on sunny afternoons. Plants are apparently self-fertile; flowers don't have to open to produce seed.

Plants tend to occur in open areas like trails, so trail or road improvements or trail users going off-trail could damage or destroy existing plants. Areas around existing populations are generally not overgrazed, possibly due to the steepness of the terrain. Palatability of this mallow to livestock is unknown but is apparently browsed by deer and rabbits. Primary threats, then, appear to be trampling in recreational use areas, and possibly grazing. The species may be fire-tolerant, as a population in the Catalinas survived after a fire. Known occurrences should be monitored for impending problems.

SAN CARLOS WILD BUCKWHEAT (ERIGONUM CAPILLARE):

This species is an annual that is found only in Arizona in Pinal, Gila, Graham, Cochise, and Pima counties. Habitat is generally sandy and gravelly alluvium or weathered limestone gravels along washes and riverbeds and up lower slopes of adjacent hills. It generally occurs in areas of sparse vegetation, including other annuals and scattered perennials and shrubs.

Population size appears to vary with moisture availability; greater number of plants appearing after a wet year. Plants flower in late summer (July-October).

Threats may include natural flooding, overgrazing, and off-road vehicle use. Known occurrences should be monitored.

NEEDLE-SPINE PINEAPPLE CACTUS (ECHINOMASTUS E. ERECTOCENTRUS):

This cactus occurs only in Pima and Cochise counties, Arizona, and blooms in April. Habitat includes soils with rock and gravel over a sandstone conglomerate on alluvial fans and hills from 3,000 to 4,600 ft elevation. Sonoran desertscrub-semidesert grassland ecotone. At this site it was found on limestone hills above upper Buehman Canyon in Pima County.

The primary threat is probably collection for the cactus trade; secondarily, trampling by livestock. Known occurrences should be monitored for impending problems.

SALVIA AMISSA

A perennial herb restricted in range to south central Arizona. Habitat is shady canyon bottoms on alluvial benches in the understory of deciduous broadleaf riparian forest. Elevational range from 1,500 to 5,000 ft. Flowers in late summer (July to October). Biology of this species unknown. Livestock grazing, erosion of floodplain terraces

(which support mature mixed broadleaf trees), and sedimentation of plant sites in canyon bottoms due to degradation of adjacent uplands are potential threats. Known occurrences and adjacent uplands should be monitored for impending problems.

STRESS ASSESSMENT:

A summary of stessors affecting this area is presented in Table 2.

Table 2. STRESS ASSESSMENT

STRESS	SOURCE OF STRESS	IMPACT OF STRESS
Reduced baseflows and lowered groundwater table	groundwater pumping for agricultural irrigation and surface water diversions loss of beaver stream entrenchment degradation of watershed condition evapotranspiration by woody riparian plants drought	extirpation of native fish segregation of native fish populations loss of native riparian vegetation and change in community composition and structure greater likelihood that saltcedar can outcompete cottonwood-willow more rapid runoff of surface and base flows; reduced recharge; reduced bank storage rapid runoff of surface flows; reduced recharge less infiltration for groundwater recharge due to more rapid runoff from uplands

Table 2 STRESS ASSESSMENT BY ZONE				
CONSERVATION ZONE	CONSERVATION	STRESSES	SOURCES	IMPACTS
ZONE 1 SAN PEDRO RIVER	Cottonwood-willow forest Mesquite bosque Sacaton grassland Cienega Migratory corridor Native fish Lowland leopard frog Riparian birds Beaver	Reduction of Base Flows	Agricultural Pumping Watershed Degradation/Reduction of Mountain Front recharge Industrial Uses (Mining) Domestic Water Supply	Recruitment of Native Riparian Forest Species Reduced Loss of riparian patch dynamics Habitat structure and diversity lost for riparian obligate bird species Diversity of food sources for migrating neotropical bird species reduced Increased stress on amphibians and increased disease incidence Cottonwood-Willow forest reduced and unavailable for use as food and construction material by Beaver Loss of native fish habitat and fish species diversity
ZONE 1 SAN PEDRO RIVER	Cottonwood-willow forest Mesquite bosque Sacaton grassland Cienega Migratory corridor Native fish Lowland leopard frog Riparian birds Beaver	Habitat Conversion	Agricultural Clearing Displacement by Exotic Species Rural Development/Housing Roads Mining	Riparian dependant native wildlife species displaced and reduced in numbers Monocultures of plants and increased ground disturbance from agriculture favors imbalance in bird populations leading to increases in harmful species such as cowbirds Increased nest predation of cup nesting songbirds Loss of food sources for riparian dependent bat species

CONSERVATION ZONE	CONSERVATION	STRESSES	SOURCES	IMPACTS
ZONE 1 SAN PEDRO RIVER	Cottonwood-willow forest Mesquite bosque Sacaton grassland Cienega Migratory corridor Native fish Lowland leopard frog Riparian birds Beaver	Declining and Fluctuating Groundwater levels	Agricultural Uses Downcutting of Stream Channel Watershed Conditions Mining Use Domestic Use	Reduction in recruitment of native riparian forest species Conversion of native riparian forest to exotic salt cedar Reduction of breeding bird habitat Reduction of habitat diversity in riparian migratory corridor Loss of base flow and extent of perennial stream
ZONE 1 SAN PEDRO RIVER	Cottonwood-willow forest Mesquite bosque Sacaton grassland Cienega Migratory corridor Native fish Lowland leopard frog Riparian birds Beaver	Water Quality	Agricultural Use Salinity Increase BOD Increase Fertilizer/Pesticide contamination Nutrient enrichment Bacterial Contamination Mining Heavy Metals Contamination Sediment Loading Ph Changes DO Reduction	Increased stress and disease incidence for lowland leopard frogs and other amphibians Habitat quality for native fish reduced Poor water quality favors non-native fish Decreased usability for human contact
ZONE 2 CANYON RIPARIAN AND WILDLIFE CORRIDOR	Mixed Broadleaf forest Migratory corridor Lowland leopard frog Longfin dace Riparian birds	Disruption of Wildlife Corridor	Growing recreational pressure from Tucson basin Dirt Bikes, Mountain Bikes, ATVs Proposed prospecting and mine development	Periodic reduction of animal use because of conflicts with human presence Destruction of habitat through construction of prospecting roads Destruction of habitat by vehicular campers Increase in sedimentation from

CONSERVATION ZONE	CONSERVATION	STRESSES	SOURCES	IMPACTS
ZONE 2 CANYON RIPARIAN AND WILDLIFE CORRIDOR	Mixed Broadleaf forest Migratory corridor Lowland leopard frog Longfin dace Riparian birds	Reduction of Base Flows	Proposed mine development would use significantly more water	Loss of recruitment of mixed broadleaf species Reduction of perennial flow area and pools Extirpation of leopard frog from Canyon Extirpation of longfin dace from Canyon
ZONE 2 CANYON RIPARIAN AND WILDLIFE CORRIDOR	Mixed Broadleaf forest Migratory corridor Lowland leopard frog Longfin dace Riparian birds	Degradation of Water Quality	Proposed mine development would create large disturbed areas, increase acreage of roads, increase use of chemicals such as sulfuric acid, and increase likelihood that poisonous leachates would be released to canyon Increased vehicular use by recreational users would increase release of VOCs and sedimentation from disturbed soils in roads and	Extirpation of aquatic dependent species such as longfin dace and lowland leopard frog would be likely Insects with aquatic life stages would be reduced or extirpated with related impacts to insect feeding bats and birds
ZONE 3 WATERSHED ENHANCEMENT	Mixed Broadleaf forest Migratory corridor Lowland leopard frog Longfin dace Riparian birds Rare plants	Suppression of Fire	poor lifestock management fire suppression policies	Loss of perennial native grasses Encroachment by woody shrub species More rapid surface runoff Fire suppression may unknown effects on some rare plants
ZONE 3 WATERSHED ENHANCEMENT	Mixed Broadleaf forest Migratory corridor Lowland leopard frog Longfin dace Riparian birds Rare plants	Incompatible recreational use	Increasing human population in nearby Tucson Basin Network of roads permitting access	Increase in surface runoff and sedimentation Increased habitat destruction Permits increased access to sensitive natural resources in zones 1 and 2

***CONSERVATION ZONES*:**

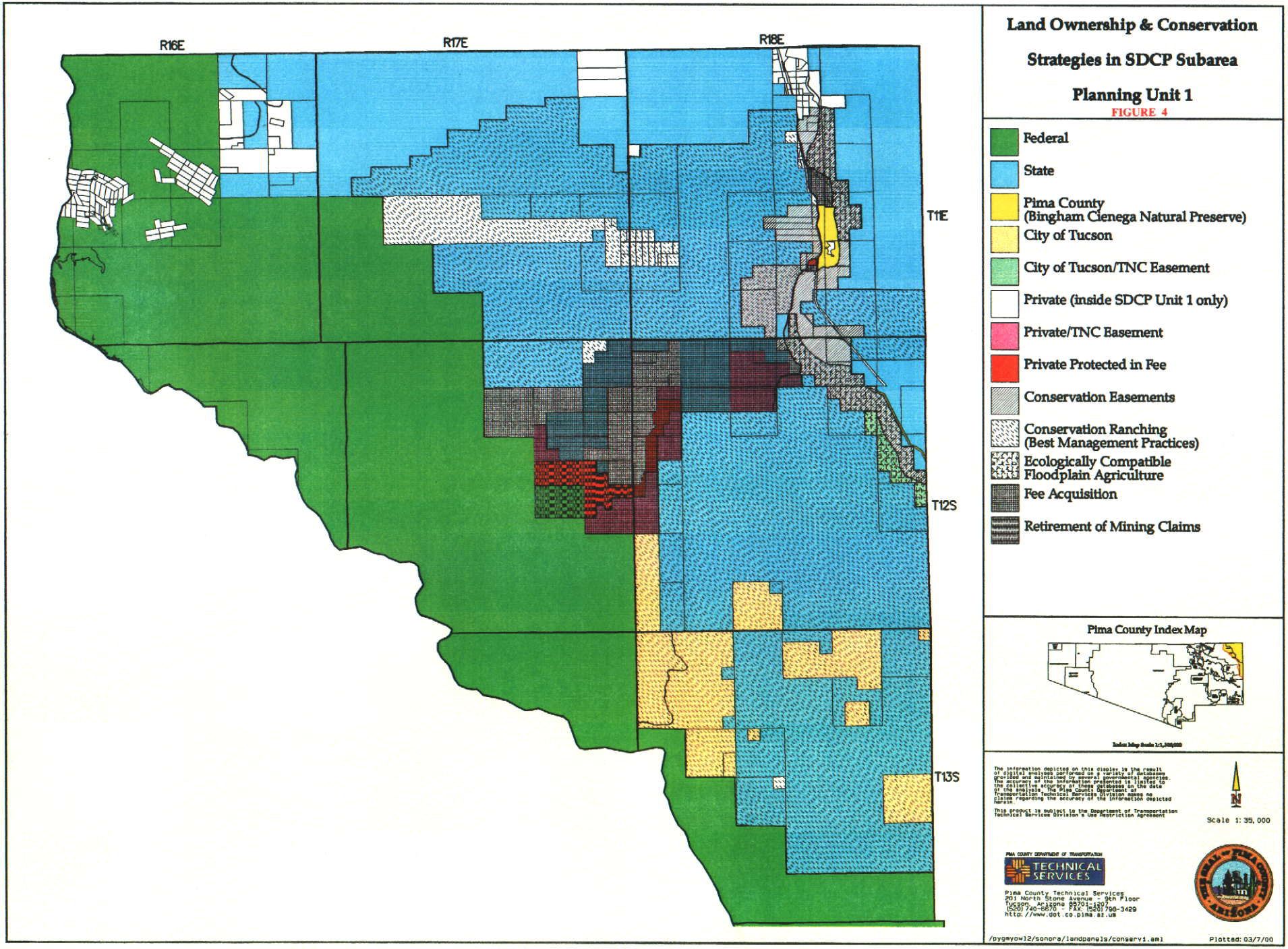
Figure 4 shows potential conservation zones for the middle San Pedro Subarea

ZONE 1: ***San Pedro River*** – Includes approximately twelve miles of the channel and riparian zone of the San Pedro River from the Pima-Cochise County line to the downstream boundary at the Pima-Pinal County line. This core area includes remnants of cottonwood-willow forest, mesquite bosque; migratory corridor and nesting habitat for neotropical migrant birds. Because of past land uses there are many opportunities for restoration of aquatic and floodplain communities and terrace communities such as mesquite bosque and sacaton grasslands. This area also includes the mouths of Buehman Canyon, Redfield Canyon, Peck Canyon, and Edgar Canyon.

Strategies that might be applied in this zone include:

1) Demonstration of habitat restoration techniques at the Bingham Cienega Natural Preserve.
2) Work with BLM, Remington NRCD, City of Tucson, and private landowners on management of the riparian zone to maintain and improve riparian communities and aquatic habitat.
3) Investigate the impacts of groundwater pumping and surface flow diversion on alluvial groundwater depths, baseflows, and extent of perennial flow reaches.
4) Investigate flow management opportunities through retiring irrigation wells or modifying pumping regimens to enhance groundwater conditions in the stream alluvium.
5) Formulate native fish recovery actions as part of a broader set of strategies for the San Pedro River basin.
6) Explore feasibility of beaver restoration and ways to enhance the likelihood of natural reestablishment in collaboration with AGFD and Remington NRCD.
7) Facilitate further fee and/or easement acquisition by conservation interests in the core riparian area.
8) Create a habitat mosaic where low ET natural communities (i.e., sacaton grassland, upland native grasses) can complement irrigation reduction locally.
9) Devise ways to accommodate residential subdivision and development that won't compromise conservation and restoration of riparian communities.
10) zoning for fire management to allow for frequent burning to perpetuate sacaton, and to control fuel loads in bosques and cottonwood-willow forests.

ZONE 2: Canyon Riparian and Wildlife Corridor -- Includes all of Buehman Canyon downstream to its confluence with the San Pedro River, most of Bullock Canyon and Redfield Canyon within Pima County. Buehman Canyon contains the most extensive known reach of perennial flow west of the river in the middle San Pedro basin and supports good occurrences of mixed broadleaf deciduous riparian forest, longfin dace, and lowland leopard frogs. Buehman Canyon is also believed to provide an important



Land Ownership & Conservation Strategies in SDCP Subarea

Planning Unit 1

FIGURE 4

- Federal
- State
- Pima County (Bingham Cienega Natural Preserve)
- City of Tucson
- City of Tucson/TNC Easement
- Private (inside SDCP Unit 1 only)
- Private/TNC Easement
- Private Protected in Fee
- Conservation Easements
- Conservation Ranching (Best Management Practices)
- Ecologically Compatible Floodplain Agriculture
- Fee Acquisition
- Retirement of Mining Claims

Pima County Index Map

Index Map Scale 1:1,200,000

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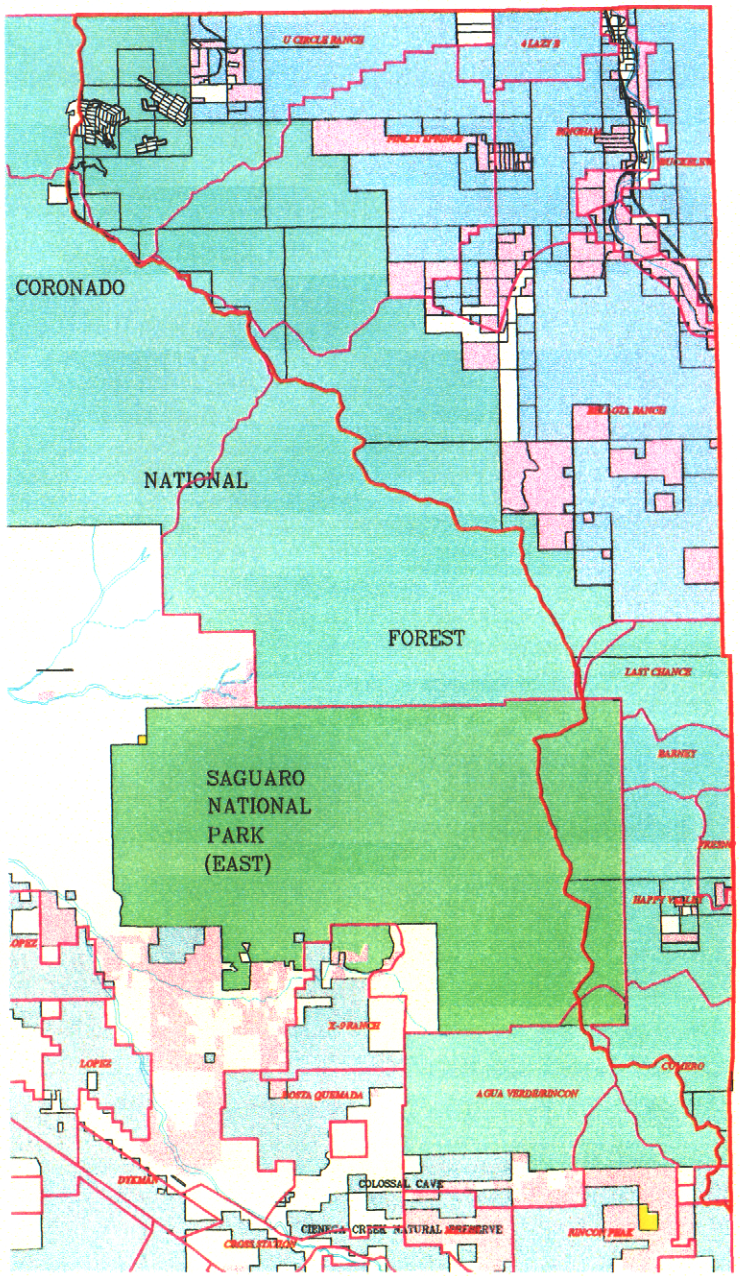
/pygmyowl2/sonora/landpanels/conserv1.aml

Plotted: 03/7/00

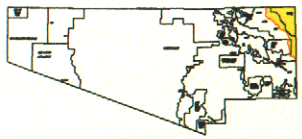
Pima County Ranches



SDCP PLANNING UNIT 1

- Planning Unit Boundary
- Ranch Boundaries
- Major Washes
- Parcel Lines
- BLM - 0 ac.
- NATIONAL FOREST LANDS - 73,030 ac.
- NATIONAL PARKS AND MONUMENTS - 8,901 ac.
- PRIVATE LANDS - 25,342 ac.
- STATE LANDS - 66,974 ac.
- RANCH USE - 18,331 ac.

Pima County Index Map



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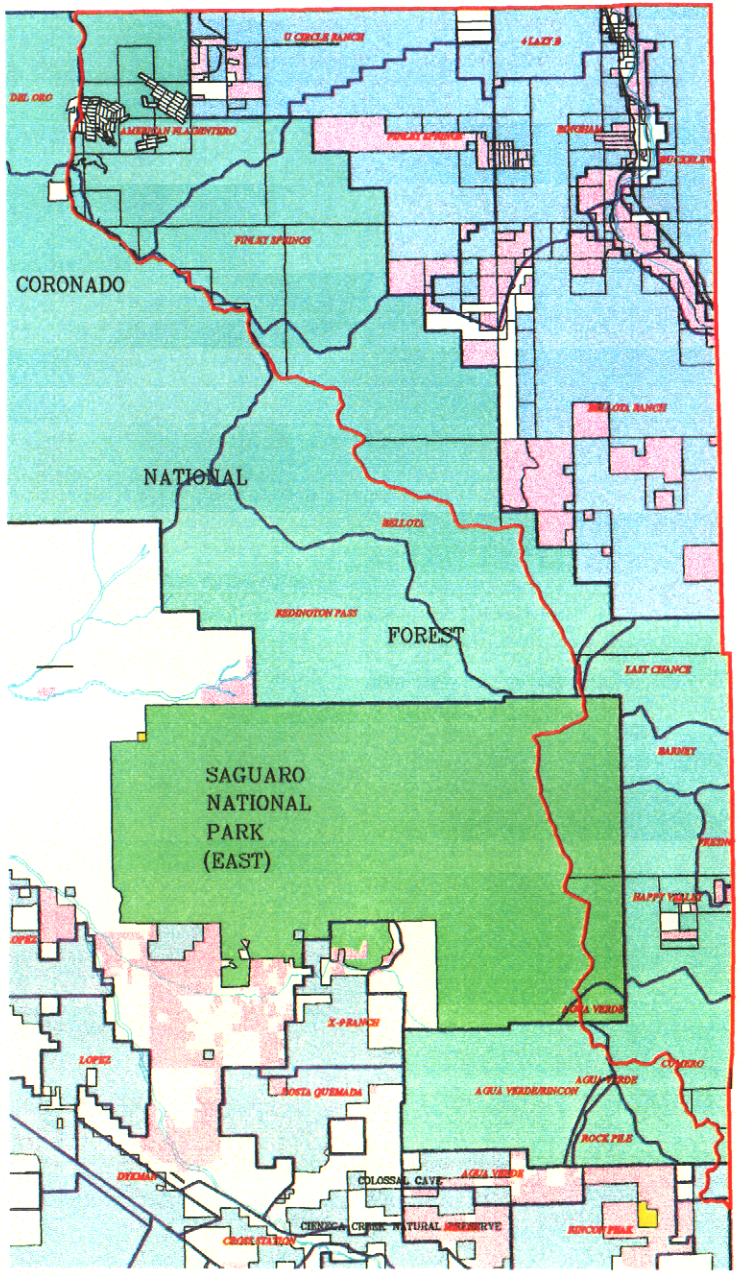
Ranch Lands and Grazing Allotments

SDCP PLANNING UNIT 1



- Planning Unit Boundary
- Grazing Allotments
- Major Washes
- Parcel Lines
- BLM - 0 ac.
- NATIONAL FOREST LANDS - 73,030 ac.
- NATIONAL PARKS AND MONUMENTS - 8,901 ac.
- PRIVATE LANDS - 25,342 ac.
- STATE LANDS - 66,974 ac.
- RANCH USE - 18,331 ac.

STATISTICS FOR PLANNING UNIT 1

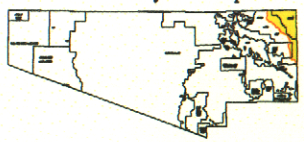
NATIONAL FOREST LANDS	73,030 AC
NATIONAL PARKS AND MONUMENTS	8,901 AC
STATE LANDS	66,974 AC
PRIVATE LANDS	25,342 AC

of the private lands,

RANCH USE	18,331 AC
NON RANCH USE	7,011 AC

598 parcels

Pima County Index Map



Index Map Scale 1:1,000,000

N

Scale 1: 70,000

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travel corridor for many wildlife species moving between the Santa Catalina and Galiuro Mountains. Bullock Canyon contains extensive segments of at least intermittent flow, relatively long stretches of riparian forest, and both longfin dace and leopard frogs.

Strategies that might be applied in this zone include:

1) Acquisition of additional private lands and state lease lands within Buehman Canyon watershed and Redfield Canyon within Pima County.
2) Biological assessment of riparian and aquatic significance of Bullock Canyon.
3) Work to retire minerals claims in upper Buehman canyon.
4) Share biological information about canyon system with USFS as part of revision of Coronado Forest Plan.

ZONE 3: Watershed Enhancement: Includes the watershed areas of Edgar Canyon, Espiritu Canyon, Youtcy Canyon and watershed areas of the San Pedro River. The objective in this zone is to improve the overall condition of the watersheds surrounding the tributaries to the San Pedro River and the San Pedro River proper. The outcome hoped for is improvement of watershed and riparian habitat conditions by increasing the percent of coverage by native perennial grasses, reduction of the shrub cover and increase in distribution of mixed broadleaf habitat and increase in flows.

Strategies that might be applied in this zone include:

1) Implementation of best management practices for ranching.
2) Support adoption of a conservation ranching philosophy by cooperators of Remington NRCD.
3) Operation of the City of Tucson A7 ranch as a grassbank to obtain basin wide benefits to watershed conditions.
4) Voluntary agreements with landowners designed to maintain or improve watershed conditions.
5) Work with the local NRCD and public agencies on watershed improvement projects.
6) Work with ASLD and lessees on better management of state trust lands.
7) Explore options for placing state trust lands into sustained open land status or developing long-term leasing/sale arrangements for trust lands with significant conservation value.
8) Develop a funding mechanism to support projects and programs such as those listed above.

REFERENCES:

Addley, C. and T. Hardy. 1995. Sonoita Creek instream flow study. Technical report prepared for The Nature Conservancy, Arizona Chapter.

Baird, K.J., M.J. Ronayne, and T. Maddock III. 1997. Preliminary vegetation and hydrologic analyses for Bingham Cienega. Unpublished report to Arizona Nature Conservancy, Pima County Flood Control District, and AZ Game & Fish Dept.

Barber, W.E. and W.L. Minckley. 1966. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. Southwestern Nat. 11:313-324.

Beier, P. 1993. Determining minimum habitat areas and habitat corridors for cougars. Conservation Biology 7:94-108.

Beier, P. and R.F. Noss. 1998. Do habitat corridors provide connectivity? -- a review and suggestions for future research. Unpublished Draft manuscript.

Boyle, K.A. and T.T. Fendley. 1987. Habitat suitability index models: bobcat. U.S. Fish and Wildlife Service Biol. Report 82(10.147)

Bristow, K., R. Olding, R. Schweinsburg, J. Wennerlund, and R. Lee. 1996. Habitat use and movements of desert bighorns near Silverbell Mine. Research Branch Tech. Report No. 25, AZ Game and Fish Dept, Phoenix.

Bryan, K. 1925. Date of channel trenching (arroyo cutting) in the arid Southwest. Science 62:338-344.

Bryan, K. 1928. Change in plant associations by change in ground water level. Ecology 9:474-478.

Clarkson, R.W. and W.L. Minckley. 1988. Morphology and foods of Arizona catostomid fishes: C*atostomus insignis, Catostomus clarki*, and their putative hybrids. Copeia 1988:422-433.

Cooke, P.St.G. 1938. Cooke's journal of the march of the Mormon Battalion, 1846-1847. *In:* Exploring Southwest trails, 1846-1854. Southwest Hist. Ser., vol. 7. Arthur H. Clark Co., Glendale, CA.

Cunningham, S.C., L.A. Haynes, C. Gustavson, and D.D. Haywood. 1995. Evaluation of the interaction between mountain lions and cattle in the Aravaipa-Klondyke area of southeast Arizona. Research Branch The. Report No. 17, AGFD, Phoenix.

Davis, G.P. 1982. Man and wildlife in Arizona – the American exploration period 1824-1865. N.B. Carmony and D.E. Brown (eds.). AZ Game and Fish Dept., Phoenix.

Eccleston, R. 1950. Overland to California on the Southwestern trail, 1849. Diary of Robert Eccleston. G.P. Hammond and E.H. Howes (eds.) Univ. of Calif., Berkeley.

Fisher, S.G., D.E. Busch, and N.B. Grimm. 1981. Diel feeding chronologies in two Sonoran Desert stream fishes, *Agosia chrysogaster* (Cyprinidae) and *Catostomus clarki* (Catostomidae). Southwest. Nat. 26:31-36.

Glinski, R. L., et al. 1986. Proceedings of the Southwest Raptor Management Symposium & Workshop. National Wildlife Federation. 395p.

Gori, D. 1996. Monitoring Plan for Sonoran Fremont cottonwood-Goodding willow riparian forest. Unpublished report for The Nature Conservancy, Arizona chapter.

Hardy, T.B., B. Bartz and W. Carter. 1990. Instream flow recommendations for the fishes of Aravaipa Creek, Arizona. Submitted to The Nature Conservancy. Twelve-Nine, Inc. Logan, UT.

Hendrickson, D.A. and W.L. Minckley. 1984. Cienegas – vanishing climax communities of the American Southwest. Desert Plants 6:130-175. [In particular, pgs 144-150, dealing with the San Pedro River]

Hutton, N.H. 1859. Engineers report – El Paso and Fort Yuma wagon road. *In:* Records of the Office of the Secretary of the Interior relating to wagon roads, 1857-1881. National Archives Film Microcopies M95: roll 3.

Jahnke, P. 1994. Modeling of groundwater flow and surface/groundwater interaction for the San Pedro River basin from Fairbank to Redington, Arizona. Unpublished draft report to the ADWR and Arizona Nature Conservancy.

Kepner, W.G. 1982. Reproductive biology of longfin dace (*Agosia chrysogaster*) in a Sonoran Desert Stream, Arizona. M.S. thesis. Arizona State University, Tempe. 77 p.

Krausman, P.R. 1998. The use of xeroriparian systems by desert mule deer. The Arizona Riparian Council Newsletter 11: 11-12.

Lawhead, D.N. 1984. Bobcat *Lynx rufus* home range, density, and habitat preference in southcentral Arizona. Southwestern Naturalist 29:105-113

Leach, J.B. 1858. Itinerary of the El Paso and Fort Yuma wagon road expedition. National Archives Film Microcopies M95, roll 3.

Lombard, J.P. 1998. Modeling report for San Pedro River stream flow simulations during the time period 1998-2028 using the University of Arizona Middle San Pedro River Basin MODFLOW model. Draft report prepared for The Nature Conservancy, Arizona Chapter.

Lowe, C.H., D.S. Hinds, and E.A. Halpern. 1967. Experimental catastrophic selection and tolerances to low oxygen concentration in native Arizona freshwater fishes. Ecology 48:1013-1017.

Malusa, J. and J.M. Porter. 1990. A biotic survey of Buehman, Espiritu, Youtcy, and Roble canyons in the Redington Pass region, Arizona. Report prepared for Riley West, Inc.

Mazzoni, J., L.T. Green III, A.M. Phillips III, B.G. Phillips, and N. Brian. 1982. Status report on Neolloydia erectocentra var. erectocentra. Prepared for U.S. Fish and Wildlife Service, Albuquerque, New Mexico, 11 p.

Miller, R.R. 1961. Man and the changing fish fauna of the American southwest. Pap. Mich. Acad. Sci., Arts and Letters 46:365-404.

Minckley, W.L. 1969. Aquatic biota of the Sonoita Creek basin, Santa Cruz County, Arizona. Ecological Studies Leaflet 15:1-8.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game Fish Dept., Phoenix. 293 p.

Minckley, W.L. 1981. Ecological studies of Aravaipa Creek, central Arizona, relative to past, present, and future uses. Final Report, Contract Number YA-512-CT6-98, U.S. Bureau of Land Management, Safford, Arizona. 362 p.

Minckley, W.L. and W.E. Barber. 1971. Some aspects of biology of the longfin dace, a cyprinid fish characteristic of streams in the Sonoran Desert. The Southwestern Naturalist 15:459-464.

Mollohan, C..M. 1987. Black bear habitat use in northern Arizona. Research Branch final report, AGFD, Phoenix.

Montgomery, E.L. 1963. The geology and groundwater investigation of the Tres Alamos dam site of the San Pedro River, Cochise Co., AZ. M.S. Thesis, U. Of AZ. 61 p.

Ough, W.D. and J.C. deVos, Jr. 1984. Intermountain travel corridors and their management implications for bighorn sheep. Desert Bighorn Council Transactions 1984:32-37.

Parke, J.G. 1857. Report of exploration for railroad routes. *In:* Explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean. U.S. 33rd Congress, 2nd session, Senate Ex. Doc. 78, vol. 7, p.24-25.

Pattie, J.O. 1833. The personal narrative of James O. Pattie, of Kentucky. E.H. Flint. Cincinnati.

Reynolds, S.J. 1988. Geologic map of Arizona. Arizona Geological Survey Map 26.

Reichenbacher, F.W., R.J. Shmalzel, and S.J. Bainbridge. 1993. Status report, Erigonum capillare. Prepared for U.S. Fish and Wildlife Service, Ecological Services, Phoenix, Arizona.

Richter, B. 1990. Playing in the Cascabel bathtub. TNC memorandum dated August 3, 1990.

Risser, A.C., Jr. 1963. A study of the coati mundi *Nasua narica* in southern Arizona. M.S. Thesis, University of Arizona, Tucson.

Riverside Technology, Inc. 1992. An assessment of well and stream water quality along the San Pedro River near the Town of Cascabel, Arizona. A report prepared for TNC-AZFO.

Ross, S.T. 1991. Mechanisms structuring stream fish assemblages: are there lessons from introduced species? Environ. Biology of Fishes 30: 359-368.

Smith, G.R. 1966. Distribution and evolution of North American catostomid fishes of the subgenus *Pantosteus,* genus *Catostomus*. Misc. Publ. Mus. Zool., Univ. Mich. No. 129.

Sredl, M.J. (ed.). 1997. Ranid frog conservation and management. Technical Report 121. AGFD Nongame and Endangered Wildlife Program.

Stromberg, J., C. Cornwall, R. Tiller, and J.D. de'Ville. 1996. Garden Canyon riparian plant ecology. Unpublished report to Fort Huachuca Army Base and The Arizona Nature Conservancy.

Stromberg, J. and D.T. Patten 1990. Seed production and seedling establishment of a southwest riparian tree Arizona walnut. Great Basin Naturalist 50:47-56.

Stromberg, J. 1998 - In Press. Dynamics of Fremont cottonwood (*Populus fremontii*) and saltcedar (*Tamarix chinensis*) populations along the San Pedro River, Arizona.

U.S. Bureau of Land Management. 1995. Instream flow water rights request: The San Pedro River - Cascabel. An analysis of water and water dependent resources in support of instream flow water rights. Report to the AZ Dept. of Water Resources and AZ Game and Fish Dept.

Van Devender, T.R., C.D. Bertelsen, and J.F. Wiens. 1994. Status report, Abutilon parishii Watson. U.S. Fish and Wildlife Service, Ecological Services, Phoenix, Arizona. 22 p.

Walker, R. and L. Oraighead. 1997. Analyzing wildlife movement corridors in Montana using GIS. Progress report -- http://www.esri.com/base/common/userconf/proc97/PROC97/TO150/PAP116/P116.HTM.

Whetstone, J. 1994. An avifauna of two riparian areas along the San Pedro River at Cascabel, Arizona. Unpublished report to the Arizona chapter of The Nature Conservancy.

Witham, J.H. and E.L. Smith. 1979. Desert bighorn movements in a southwestern Arizona mountain complex. Desert Bighorn Council Trans. 1979:20-24.

Zimmerman, R.C. 1969. Plant ecology of an arid basin, Tres Alamos - Redingon Area, southeastern Arizona. Geological Survey Professional Paper 485-D.

Chapter 4
Subarea 1 - Middle San Pedro

WATERSHED/WATERCOURSE CHARACTERISTICS

THE WATERSHED

The San Pedro River watershed begins in Mexico with the headwaters extending approximately 25 miles south of the international border south of the Sierra Vista region. The river grows gradually from a number of small streams until it flows perennially before it crosses the border in ranching and farming country. It flows north in Cochise County perennially through the San Pedro Riparian National Conservation Area to the town of Benson where it becomes a dry stream due to groundwater pumping and changes in the underlying geology. See Figure 4-1 for a map of the watershed.

The Middle San Pedro Subarea consists of the small portion of the San Pedro River Watershed which extends across the extreme northeast corner of Pima County. The subarea is located on the east side of the Santa Catalina and Rincon Mountains. The San Pedro watershed is bounded on the east by the Galiuro, Dragoon and Mule Mountains and on the west by the Catalina, Rincon, Whetstone and Huachuca Mountains. An approximately 12 mile segment of the river passes through the northeast corner of Pima County.

The San Pedro River valley through northeast Pima County consists of a sand bed river varying in width from one to several hundred feet located within a wider geologic floodplain. The San Pedro River channel bed has degraded several feet since the turn of the century (1900) as a result of overgrazing within the upstream watershed. This degradation has narrowed the floodplain and increased downstream flood peaks. Higher flow velocities associated with the channel entrenchment have increased bank erosion. This degradation has narrowed the floodplain and increased downstream flood peaks. Higher flow velocities associated with the channel entrenchment have increased bank erosion. Tributary drainage within the valley consists of fairly well defined washes draining the foothills of the Santa Catalina and Rincon Mountains to the west and the Galiuro Mountains (in Graham and Cochise Counties) to the east. The uppermost portions of the watershed within Pima County extend into the highest reaches of the Santa Catalina and Rincon Mountains with elevations exceeding 9,000 feet near the summit of the Santa Catalina Mountains. Elevations along the San Pedro River range from nearly 3,000 feet where it enters the county to about 2,700 feet where it exits into Pinal County.

Several perennial and intermittent streams flow from the higher elevations of the subarea. Buehmann Canyon is the most biologically significant of these.

HUMAN IMPACTS ON THE WATERCOURSES

Figure 4-1 depicts the watershed. Human impacts on the watercourses are discussed below and the major impacts summarized generally on Figure 4-3.

TRANSPORTATION

There are no major highways within the area. In fact the only paved, county-maintained road is a short segment of roadway associated with the Redington bridge over the San Pedro River. Access to the area is limited to the graded road which runs along the San Pedro River entering from either Cochise or Pinal County or the rough graded dirt road which runs from the Tanque Verde valley area over Redington Pass between the Santa Catalina and Rincon Mountains.

Neither route is heavily traveled or maintained by Pima County. It is a 30-45 minute drive to Benson or San Manuel from Redington in dry weather, with another half hour to Tucson and county services. The roads can be impassable during the rainy season and are not maintained by the County. There are numerous private ranch roads.

WATER AND WASTEWATER- RELATED USES

Water Supply

In the 1960s the City of Tucson purchased land along the middle San Pedro with a view towards exporting water to the city. This project did not prove feasible and the land was eventually sold. There are no plans for exporting water from the area and such exports are no longer possible under Arizona law.

All water users in the area have their own wells which are quite productive, as the area has very shallow groundwater. There is no wastewater treatment system, homes are generally on septic systems.

EXISTING PUBLIC LAND USES

A substantial portion of the subarea is under public ownership within the Coronado National Forest. The vast majority of the remaining part is under state ownership with isolated pockets and sections of privately owned land, particularly along the river itself. Grazing is a common use of both of these areas. There is some recreational use in the National Forest.

The San Pedro River is widely regarded as one of the last remaining relatively natural southwest riparian areas. Considerable efforts have been taken to protect the river and its base flow in the upper reaches within Cochise County. The Pima County segment of the river does not flow on a regular basis. .

The180 acre Bingham Cienega Natural Preserve is located on the San Pedro River near the settlement of Redington and is managed under contract by the Arizona Nature Conservancy. The cienega was formerly part of the Bingham Cienega Ranch and contains lush riparian vegetation associated with a perennial spring at the ranch. This area is not open for recreational use, but can be accessed by tour groups with appointments. The Flood Control District and the Conservancy are actively involved in restoration efforts with a Water Protection Fund grant administered by a knowledgeable local resident.

Buehmann Canyon has Unique Waters status and an instream flow permit has been applied for on this stream. It is managed by the Arizona Nature Conservancy which owns and holds conservation easements on 2,793 acres of the stream and its environs. The Conservancy bought the area at a time when mining activities were imminent and now operate the property to maintain its natural state, but mining activities are still possible in the future on parts of the land. This area is only open to the public on a very limited tour basis.

Most recently, the Bellota Ranch was put up for sale for development. In an effort to stem development of the area, the City of Tucson bought 6,800 acres of private land and 34,200 acres of state-land grazing leases that were part of ranch. The intent is to preserve the area as open space. This is not currently open to the public for recreational use.

EXISTING PRIVATE LAND USES

The only developed area is the small community of Redington located about midway along the Pima County segment of the river. Some residents produce pottery, wood products, and crafts. Some of the residents have joined in efforts to protect the river and its tributaries from damage and repair past damage. The Redington Natural Resource Conservation District has been actively involved in streambed restoration through a Water Protection Fund grant which involved

installing small check dams on tributaries to collect sediment and correct problems caused by past erosion.

Ranching has been the predominant human activity within the non-federally owned portion of the subarea and on some leased public land. Some descendants of the original pioneers still own property and live in the area. Some of the areas are farmed, although less so than in earlier times.

PROJECTED LAND USES

Although this area is isolated geographically and accessed by roadways of limited capacity, this area is also likely to see development pressure as area residents continue to seek out locations to live which lie beyond the metropolitan urban area. The purchase of the Bellota Ranch by the City of Tucson is one step toward controlling development in the area. Potential impacts of development in the area include continued degradation of stream flows in the San Pedro River and potential lowering of the stream and its tributaries as the sediment supply to the natural system is altered through urbanization.

In the Mountain Parks and the Sonoran Desert Conservation Plan, Pima County proposes the establishment of the Buehmann-Bingham Natural Preserve, joining the two existing preserves described above. The County's Open Space Acquisition Master Plan proposes adding along 400 acres to Bingham Preserve. Almost 700 acres of the area are designated Critical Habitat for the pygmy owl.

ISSUES FOR DISCUSSION

The major general options for watercourse protection and improvement are summarized in Figure 4.

PRESERVES

Should Pima County's open space proposals be implemented? Are additional preserved areas needed? Should some State Trust Land in this area be preserved as open space?

CONVERSION OF RANCHES

If ranches in the area are to be available for sale, should any measures be taken to preserve the area as open space? Should they be rezoned to allow for subdivision or ranchette development? If they are developed, what provisions should be made to ensure that the groundwater table is not lowered? Should land be purchased to ensure that new pumping does not adversely affect the water supply for Bingham Cienega?

ROAD PAVING/WIDENING

The major north-south road in the area is currently unpaved, not maintained by the county, and is not accessible in all weather. Should it be improved? If so, how should the crossings be treated?

MINING

If new proposals for mining in the National Forest were forthcoming, should local governments play a role in the approval decisions? What limits should be placed on new mining to protect the watercourses?

REHABILITATION OF THE RIVER

Should efforts be made to revegetate the river or otherwise improve the habitat of the area?

Region Within the Subarea	Grazing	Wildcat Subdivision	Planned Subdivision	Copper Mine	Sand & Gravel Mine	Pumping	Agriculture	Recreation
River area	X	P	P			X	X-	X
Mountains and foothills	X			P				X

Key: X = Existing X+ = Existing with potential to increase X- = Existing with potential to decrease
X+- = Existing with potential to increase or decrease P = Potential

Figure 4-3. Generalized Matrix of Potential and Existing Impacts on Watercourses in the Middle San Pedro Subarea

Region Within the Subarea	Alternate Water Less Pumping	More Non-structural Floodplain Management	Stricter Land Use Management	Federal Public Lands Expansion	State Trust Land Preserved	Other Preserves Increase	Better Grazing Management
River area			X				X
Mountains and foothills				X			X
Key: X = Is possible and could have significant impact if it occurred.							

Figure 4-4. Generalized Matrix of Potential Options for Reducing Stress on Watercourses in the Middle San Pedro Subarea

Ranching in the San Pedro Valley: Descriptive Summary

Introduction:

Long subject to raiding by Apaches and isolated by the Catalina Mountains from the relative safety of the military presence in the Tucson area, the initial settlement of the San Pedro River Valley with homesteaders and ranchers began somewhat later in this valley than elsewhere. Today the valley is comprised of a number of traditional ranches that continue in operation in this subarea, comprised of approximately 174,315 acres (272.4 square miles) in Pima County.

Land & Environmental Setting:

Located to the east of the Tucson Basin and running parallel to the Santa Cruz valley, the San Pedro River flows north from the border with Mexico to the Gila River. Unlike the urbanized Tucson area and the Santa Cruz River valley, the San Pedro valley is largely rural and undeveloped, with its principal towns at Benson, San Manuel, Mammoth, and at Hayden and Winkelman at its junction with the Gila River. In Pima County, the settlement of Redington is located just east of Redington Pass through the Santa Catalina Mountains.

The San Pedro watershed in Pima County includes a portion of the San Pedro River and the uplands of the Santa Catalina Mountains. Bounded by the Pinal County line on the north, Graham County and Cochise County on the east, and the Santa Catalina Mountains and Rincon Mountains on the west and south, this watershed reflects a significant range in elevation from 2798 to 8595 feet.

The rugged mountain terrain and river valley support a variety of environmental zones and vegetation types, ranging from the Bingham Cienega swamp along the San Pedro floodplain to high elevation evergreen forests in the Santa Catalina Mountains.

Table 1. Major Vegetation Zones in the San Pedro Valley Watershed in Pima County

▸	Irrigated pasture	2131	acres	1.2 percent
▸	Water surface	60		0.1
▸	Cottonwood	661		0.3
▸	Paloverde Scrub	23,083		13.3
▸	Creosote Scrub	8139		4.7
▸	Deciduous/Riparian	1386		0.7
▸	Scrub Grassland	79,709		45.8
▸	Mixed Scrub	5296		3.0
▸	Chaparral Scrub	3330		1.9
▸	Pine Forest	6628		3.9
▸	Mixed Conifer Forest	1087		.6
▸	Oak - Pine Forest	324		0.2
▸	Evergreen Forest	42,481		24.3
	TOTAL	174,315	acres	100.0 percent

Because of the range in elevation, rainfall, too, is highly variable ranging from about 12-15 inches annually at the lowest elevations to an estimated 35 inches at the highest elevations, with much of this forming snowpack in the winter months at the highest elevations. Most of the rainfall in this watershed is estimated to average about 15 - 25 inches annually. This amount of rainfall covers nearly 90 percent of the subarea acreage.

Water is available from numerous springs found mostly in the mountains on the Coronado National Forest, a number of perennial streams emanating from the mountains, and the San Pedro River itself. Stock tanks in the lower elevations and wells supplement these natural water sources for cattle and wildlife use.

Table 2. Natural & Constructed Water Sources in the San Pedro Watershed in Pima County

Springs	Streams	San Pedro River	Stock Tanks	Shallow Water	Wells
66	ca. 4mi.	ca. 10 mi.	302	2102 acres	252

As a consequence of its natural environmental setting that includes an abundance of grassland totaling about 46 percent of the vegetation in the valley, numerous natural and created water sources, and a range of environmental zones, which can be seasonally grazed, ranching in the San Pedro Valley watershed comprises a significant and sustainable land use.

Land Base & Land Uses:

All of the San Pedro Valley subarea is located in unincorporated Pima County, and like much of Pima County, the San Pedro Valley is comprised of a mosaic of land ownership including federal, state, and private lands. However, unlike most of the other valleys, there is no BLM land identified in the Pima County GIS system in this subarea, but a significant portion of this land is publicly owned. Approximate acreages are provided below for each kind of ownership.

Table 3. Land Ownership & Jurisdictions

National Forest	73,030 acres	42 percent
National Parks	8,901	5
State Lands	66,974	38
Private Lands	25,342	15
Unknown	68	
TOTAL	174,315 acres	100 percent

Redington is the principal settlement in the Pima County portion of this watershed, and the total population in the area is estimated at 66. Private lands, comprising some 15 percent of the land base, are located principally along the San Pedro River and in the upper bajada and foothills area just east of the Coronado National Forest boundary. There are a total of 598 parcels recorded with the Pima County Assessor's Office.

Ranches:

Long subject to raiding by Apaches and isolated by the Santa Catalina Mountains from the relative safety of the military presence in the Tucson area, the initial settlement of the San Pedro River Valley with homesteaders and ranchers began somewhat later in this valley than elsewhere.

First settled by Henry and Lem Redfield in 1875, the Redington area just across the mountains to the east of Tucson and along the San Pedro River became the social and economic hub of this portion of Pima County. A number of ranches continue in operation in this subarea, utilizing private lands, state trust land grazing leases, and National Forest leases. These ranches include the following identified by either their ranch name or the name of the grazing lease. Please note that relatively small ranches comprised of only private lands are not noted below; however, their use of private lands in ranching is included in the total acreage in ranch use calculated for the entire watershed.

Table 4. Ranches in the San Pedro Watershed in Pima County

Ranch/Lease Name	Private Land	State Lease	National Forest Lease
U Circle Ranch	X	X	X
Finley Springs	X	X	X
4 Lazy B	X	X	
Bingham	X	X	
Bellota (A7)	X	X	X
Bayless & Berkalew	X	X	
Last Chance			X
Barney			X
Fresno	X		X
Happy Valley	X		X
Cumero		X	X

These larger ranches, which include both cow-calf and stocker types of operations, all utilize grazing and ranch management plans under which they implement their state and federal grazing leases. Moreover, a number of these federal ranch leases and management plans have been reviewed and approved pursuant to the National Environmental Policy Act (NEPA).

Unique among the ranches in the San Pedro watershed is the Bellota Ranch, also known as the A7 Ranch, which sits astride Redington Pass. This ranch has been a working ranch since the 1870s, and was once associated with the Agua Caliente Ranch, now a Pima County park, located to the west of Redington Pass. Because of its proximity to the Tucson Basin, the ranch has been subject to increasing development pressures since the late 1970s.

Recently the City of Tucson purchased the Bellota Ranch for open space and to preserve grasslands and riparian areas extending from the Coronado National Forest to the San Pedro River. Plans are in progress by the City of Tucson to continue the Bellota (A7) Ranch as a

working ranch and to establish a "grass bank" in portions of the ranch in order to maintain its open space and grazing leases while facilitating a sustainable ranching industry in the San Pedro Valley.

In the San Pedro watershed, covering 174,315 acres in Pima County, ranch lands total approximately 158,403 acres, or about 90 percent of the entire watershed. Of all private lands totaling 25,342 acres, approximately 18,331 acres, or 72 percent, are used in ranching and 7011 acres, about 28 percent, have other uses. Virtually all of the 66,974 acres of state trust lands appear to be used in grazing, and much of the National Forest lands are designated in grazing leases. However, Forest lands used in grazing leases distinguish between "capable" range land and "incapable" range land due to rugged terrain and poor access in the higher elevations. Nominally, however, approximately 73,030 acres of National Forest lands are available for grazing in this watershed.

Table 5. Ranchlands in the San Pedro Watershed in Pima County

Land Owner	Ranch Use	Non-Ranch Use	Total
National Forest	ca. 73,030 ac	(Rugged terrain?)	73,030 ac
State Trust Land	66,974		66,974
National Park Service		8,901	8,901
Private Owners	18,331	7,011	25,342
Unclassified		68?	68
TOTAL	158,335 ac	15,980 ac	174,315 ac

Ranch improvements that have been made include ranch headquarters, residences, stables, corrals, irrigated pasture, fencing for lease boundaries and pasture rotation, roads and fire breaks, erosion control, and development of water resources for cattle and wildlife. While many of these improvements have not been quantified for this report, water sources that are critical to the success of ranching and for maintaining wildlife have been researched. It has been noted above in Table 2 that natural water sources are relatively abundant, with 66 springs located mostly on the Coronado National Forest and more than 10 miles of perennial and intermittent streams. To supplement natural water sources, approximately 302 stock tanks have been constructed, and approximately 252 wells, for both domestic use and for cattle and wildlife.

The "animal unit capacity," which defines the number of animals that can be grazed on leased ranch lands is determined by range managers for the US Forest Service and the State Land Department in cooperation with the rancher or lease holder. This capacity is not static but reflects current range conditions that are determined by a variety of factors including soils types, tendency to erosion, natural vegetation and forage types, elevation, rainfall, the success of grazing rotation, and the recovery of natural forage following periods of grazing or catastrophic events such as fire. Periodic review of these and other factors determines the animal unit capacity or permitted use and determines the upper limit of how many cattle can be grazed to maintain the viability of the rangeland. It does not necessarily mean that ranchers

always graze at the permitted maximum level. More often than not, many ranchers graze animals at lower than the permitted levels to further ensure the stability and health of the rangeland. If lands are overgrazed such that range health is compromised, the consequences of diminished capacity and lower economic viability for the rancher in future years are obvious.

Based on current state and federal grazing lease numbers, the current animal unit capacity of the San Pedro watershed ranges from 3 to 12 animals per square mile depending on the terrain, location of the lease, the health of the range, rainfall, and how it is used. At the present time the 11 National Forest grazing allotments and 6 State grazing leases allow for a maximum of 1917 animals to be grazed in the entire San Pedro watershed in Pima County. When this number is considered together with the total acreage dedicated to ranching, the maximum average number of animals allowed to be grazed is approximately 8 animals per square mile. Please note again that this number reflects only today's range conditions and lease terms. The total number of animal units is likely to be changed in the future dependent on climate, rainfall, vegetation, and range health.

Table 6. Animal Units Allowed to be Grazed in the San Pedro Watershed in Pima County

Range of AUs Allowed	Acres/Sq.Miles in Grazing	Total AUs Allowed	Avg.AU/Sq.Mi.
3 -12	158,335 ac. or 247 Sq.Mi.	1917	7.8

In addition to grazing, federal and state public lands may be used for hunting, fishing, hiking, riding, and other recreational uses. Although these kinds of uses have not yet been quantified, it is likely that recreational use in the San Pedro watershed is high due to its close proximity to the Tucson metropolitan area. Moreover, it is likely that recreation here is comparatively higher than in some other areas farther from Tucson.

Current Farms:

At the present time, there are apparently no food or fiber crops being commercially grown in the San Pedro watershed. However, there are some 2131 acres, located principally along the San Pedro floodplain, that are in current use or that may have been used in the past for irrigated pasture. With irrigated pasture producing sufficient alfalfa and other forage, cattle may be pastured together in greater numbers while natural range land is rested from grazing for portions of the year. Water for irrigation to these pastures may be derived from either ditches or canals from the San Pedro River or from wells.

Table 7. Current Farms or Irrigated Pasture in the San Pedro Watershed in Pima County

Acres in Agriculture	Food or Fiber Crops	Irrigated Pasture	Totals
2131	None	2131	2131

Development Pressure & Threats to Ranching:

Development pressure in the San Pedro Valley watershed in Pima County is now somewhat diminished due to the recent purchase of the Bellota Ranch by the City of Tucson. However, due to its proximity to the Tucson metropolitan area, there remains the threat that additional private lands will be developed either as subdivisions or as wildcat subdivisions. At the present time, there are no formally platted subdivisions in the San Pedro watershed in Pima County; however, there are 598 recorded parcels of land, and 7011 acres of private lands that are not currently used in ranching.

Areas of ranchland fragmentation may be defined as those parcels that are not used in ranching and that have been subdivided or have the potential to be subdivided. When reviewed on a map, these areas of non-ranch private land holdings cluster along the San Pedro River, at the Pinal County line, and to the west adjacent to the National Forest boundary. In addition, there are a number of mining claims that are identified as separate parcels in the highest elevations of the Santa Catalina mountains.

At the present time there are no areas of committed high density zoning for development. Consequently, there are also no areas for "rent-a-cow" operations where a developer uses ranch land designation by the Assessor's Office to lower property taxes while waiting for the opportune time to develop lands that have been zoned for high density residential or commercial use.

Additionally there are no BLM or State Trust Lands that have been identified for either disposal or commercial lease or purchase.

In summary, the development pressure in the San Pedro Valley watershed in Pima County is currently fairly low due to the stability of ranch land use, the lack of committed high density land use, the lack of federal or state lands designated for disposal or commercial use, its distance from any major transportation corridors, and the relatively difficult access by Redington Road to the valley. The principal threat to the stability of ranching in the San Pedro Valley may be due to its relatively close proximity to the Tucson metropolitan area and from further fragmentation of the private lands into either platted or wildcat subdivisions.

Ranchland Conservation Potential:

Several factors will contribute to the very good potential for the San Pedro Valley to remain a viable area for sustainable ranching. These factors include: the relative stability and long-term tenure of ranch lands comprised of private lands, State lands, and National Forest leases; the lack of public lands for disposal or commercial use; low population pressure; the lack of major transportation corridors; relatively difficult or circuitous access to the valley from the Tucson area; its proximity to existing preserves that include the Coronado National Forest, Saguaro National Park, and the Bingham Swamp preserve along the San Pedro River; a high proportion of productive grasslands; good average rainfall; the availability of irrigated pasture to diversify grazing strategies; and relatively high grazing capacity.

While none of these factors guarantees long-term ranchland conservation, the available information suggests that the potential for sustainable ranching is high in the San Pedro watershed in comparison to some of the other subareas of Pima County.

Summary & Conclusions:

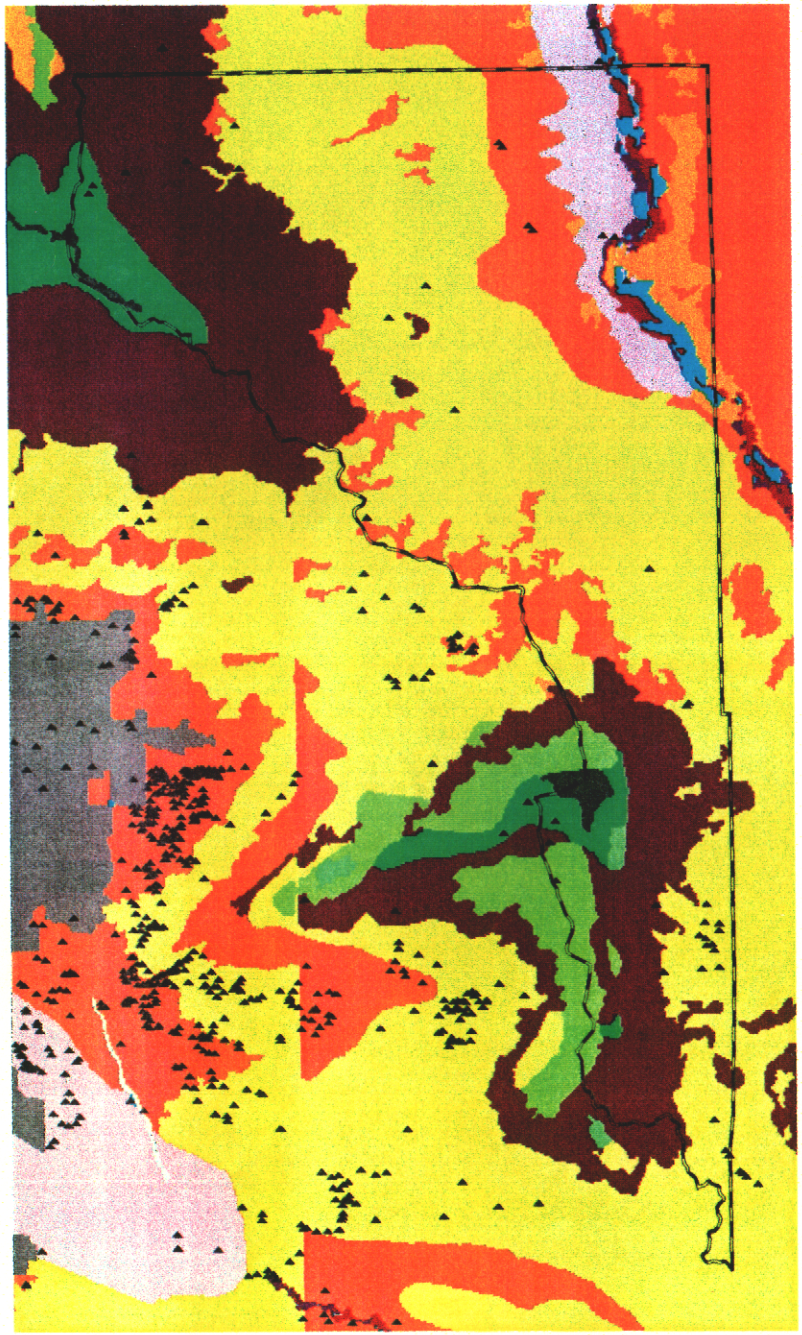
To conclude, the San Pedro Valley watershed continues to support stable and sustainable ranching operations in large part because of its environmental setting. The valley is located in a rich and varied environment that expresses a range of environmental zones from riparian bottomlands to high elevation evergreen forests, offering the opportunity to use different areas of the valley for grazing as forage becomes available seasonally. The principal vegetation type is scrub grasslands, which comprises some 46 percent of the major vegetation in the subarea.

Numerous water sources, both natural and constructed, provide water to both cattle and wildlife throughout the watershed in all elevations.

Land use remains entirely rural, and significantly, some 158,335 acres, approximately 90 percent of the land in the subarea, are used in ranching. This includes 18,331 acres, or 72 percent, of all private lands. Only 15,980 acres, or approximately 10 percent, of the entire area is not used for ranch purposes.

At the present time there is no significant threat from development pressure. Population is estimated at only 66 people, and there are no committed lands that have been zoned for high density development. The acquisition of the Bellota Ranch (A7) by the City of Tucson to preserve open space has significantly reduced the threat of urban sprawl across Redington Pass Road. In addition, there are no lands identified by either the BLM or ASLD for sale or lease for commercial purposes.

The San Pedro Valley watershed in Pima County currently has a reasonably high potential to continue in sustainable ranch use. This conservation potential derives from a productive environmental setting, the availability of water and relatively high rainfall, the apparent stability of ranchlands and grazing leases comprised of private lands, State lands and National Forest lands, the relatively high grazing capacity, the lack of public lands for sale or commercial lease, the lack of major transportation corridors, relatively difficult access to the valley, and the valley's proximity to existing preserves, much of which is used in ranching.

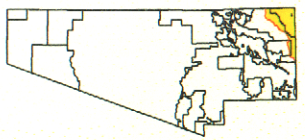


GAP Vegetation with Archaeology Site Locations

SDCP PLANNING UNIT 1

- Archaeology Sites
- Watershed Planning Unit
- Agriculture
- Urban
- Mining
- Chihuahuan Desertscrub (Creosotebush--Tarbush)
- Chihuahuan Desertscrub (Mixed Scrub)
- Chihuahuan Desertscrub (Whitethorn)
- Madrean Evergreen Forest (Encinal)
- Madrean Evergreen Forest (Oak--Pine)
- Madrean Montane Conifer Forest (Douglas-Fir--Mixed Conifer)
- Madrean Montane Conifer Forest (Pine)
- Mogollon Chaparral Scrubland (Manzanita)
- Mogollon Chaparral Scrubland (Mixed Evergreen Sclerophyll)
- Mogollon Deciduous Swampforest (Cottonwood--Willow)
- Mogollon Deciduous Swampforest (Mixed Broadleaf)
- Playa
- Scrub Grassland (Mixed Grass--Scrub)
- Scrub Grassland (Sacaton--Scrub)
- Sonoran Deciduous Swamp and Riparian Scrub (Mixed Scrub)
- Sonoran Desertscrub (Creosotebush--Bursage)
- Sonoran Desertscrub (Paloverde--Mixed Cacti)
- Sonoran Desertscrub (Saltbush)
- Sonoran Interior Marshland (Cattail)
- Sonoran Riparian and Oasis Forest (Cottonwood--Willow)
- Unclassified/Mixed
- Water

Pima County Index Map



Index Map Scale 1:1,500,000

ARCHAEOLOGY SITES BY GAP VEGETATION TYPE

5 Madrean Evergreen Forest (Encinal)
1 Madrean Montane Conifer Forest (Douglas-Fir--Mixed Conifer)
3 Madrean Montane Conifer Forest (Pine)
1 Mogollon Chaparral Scrubland (Manzanita)
23 Scrub Grassland (Mixed Grass--Scrub)
3 Sonoran Desertscrub (Creosotebush--Bursage)
4 Sonoran Desertscrub (Paloverde--Mixed Cacti)

TOTAL OF 40 SITES

N

Scale 1: 70, 000

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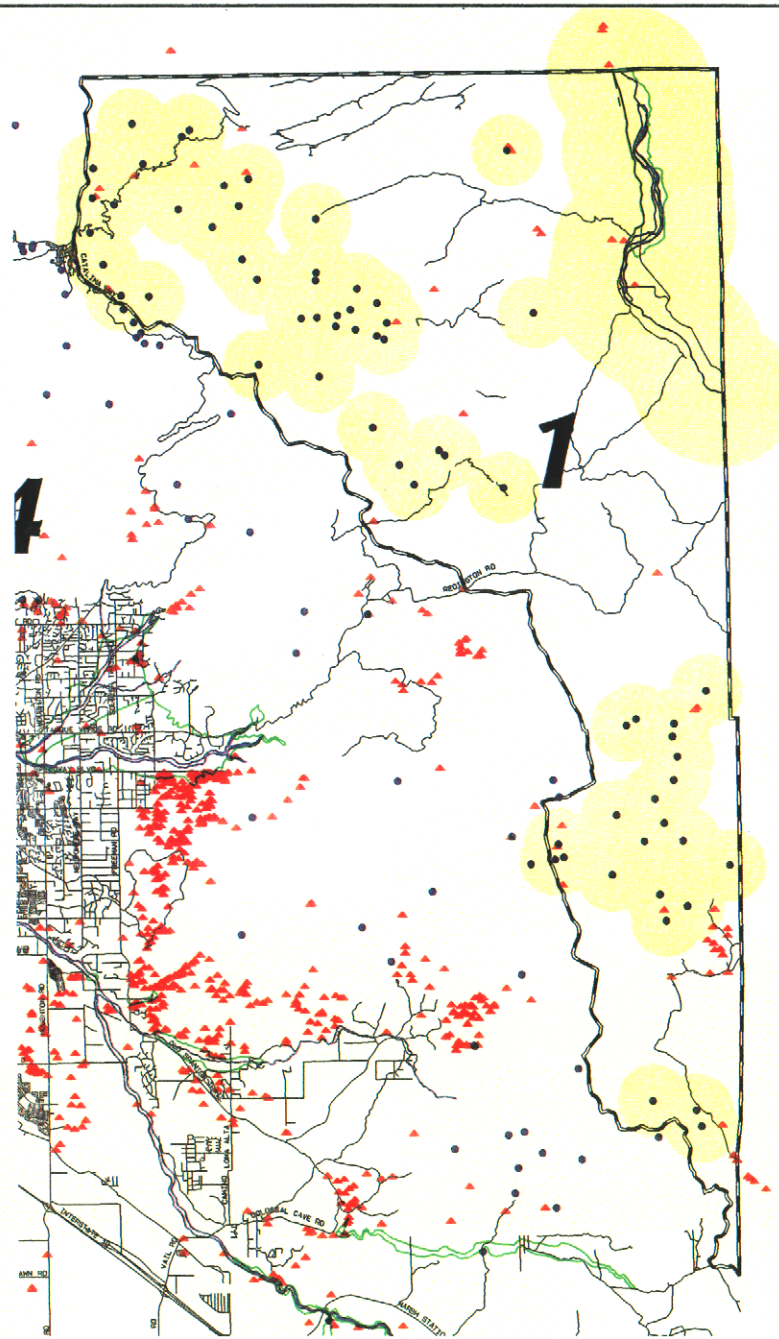
03/01/00

/pygmyowl2/sonora/cultural/asmjoined/plan1/amls/arch_gap1.aml



One Mile Buffer ~ Springs And Major Washes

SDCP PLANNING UNIT 1

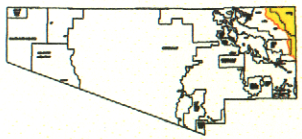
- One Mile Buffer Around Springs And Major Washes
- Streets And Roads
- Major Washes
- Subarea Boundary
- Shallow Ground Water
- Archaelogical Sites
- Springs

2 MILE WASH BUFFER = 36,648 AC.
1 MILE SPRING BUFFER = 67,733 AC.

TOTAL NUMBER OF ARCHAEOLOGY SITES: 40

NUMBER OF SITES WITHIN BUFFERED WASH AREA: 3
NUMBER OF SITES WITHIN BUFFERED SPRING AREA: 18

Pima County Index Map



Index Map Scale 1:1,500,000

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/pygmyowl2/sonora/cultural/ssmjoined/plani/gmia/washi.aml Plotted 3/01/00

Sonoran Desert Conservation Plan
San Pedro Valley Subarea
Cultural and Historical Resources Inventory Report
March 6, 2000

DRAFT (Final)

Purpose: The purpose of this report is to describe in summary form what is known about three kinds of cultural resources in the San Pedro Valley subarea: archaeological sites, historic resources, and traditional cultural places, each of which is defined below. This report is intended to provide baseline information needed to consider cultural resources in the Sonoran Desert Conservation Planning process.

Subarea: The subarea defines the San Pedro Valley watershed west of the Santa Catalina and north of the Rincon mountains, and is bounded by Pinal county to the north and Graham and Cochise counties to the east. This area encompasses approximately 278 square miles and includes the community of Redington. The San Pedro River is the principle drainage, which is one of the few remaining "live" rivers in southern Arizona. As such, the valley bottom is ideal farm land and has been used for farming since prehistoric times. Today, the San Pedro Valley retains its rural character with farming, ranching, and mining being the principle economic forces. The subarea contains an estimate 66 people and Redington is the only settlement of any size. The map entitled Modern Communities Transportation and Ownership provides a breakdown of landownership within the subarea. As is the case elsewhere, federal and state lands make up the bulk of the land base in the subarea.

Cultural Resources: This section presents information and analysis of current data on archaeological sites, historic resources and traditional cultural places within the subarea.

Archaeological sites

Archaeological sites are any material remains of past human life or activities which are preserved in their original setting that are important to understanding prehistory or history. These sites or districts may include occupation sites, work areas, farming sites, burials and other funerary remains, artifacts, campsites, hearths, rock art, intaglios, trails, battle sites, religious or ceremonial sites, caves and rock shelters, the architectural or other remains of structures of all kinds, such as pit houses, pueblo rooms, adobe or rock foundations, and other domestic features, usually dating from prehistoric or aboriginal periods, or from historic periods at least 50 years old, for which only archaeological vestiges remain.

Archaeologists learn about the past by collecting information in the field in two ways: through survey and by excavation. Survey involves inspecting the ground surface in a particular area and recording concentrations of artifacts and features (hearths, roasting pits, pit houses, etc.) as archaeological sites. A site represents the physical remains of past human behavior in a single location dating to one or more periods of use in time. Surveys are often done systematically by groups of archaeologist who sweep the land in regularly spaced lines looking for artifacts. Some surveys, however, are judgmental in that archaeologists only look where sites are expected to be found and not elsewhere. In all cases, survey offers an extensive perspective on past land use.

The second kind of information on archaeological sites is gained through excavation. This is the systematic recording, recovery, and analysis of artifacts and features from within a site's limits. Critical information is gained by understanding the spatial relationship of all artifacts and features

within a three dimensional context. This enables interpretation about how the site was used, by whom, when, whether the site was used more than once and what happened after it was abandoned. Often, archaeological sites are not fully excavated but are only partially sampled. This saves what is left of the site for future investigations. Archaeological excavation provides highly detailed information about the use of one limited spatial area during one or more use episodes. Archaeologists use survey information in conjunction with site excavation information to build regional time lines over broad areas such as a river valley.

Survey data: Archaeologists perform two kinds of surveys: Linear and block. Linear surveys involve inspection of a right-of-way for construction of a road, sewer line, telephone cable or other linear feature. These surveys tend to be done in compliance with legal mandates requiring environmental studies during project planning. Block surveys involve the examination of properties ranging from a few acres to 1000s of acres. These are typically done either in compliance with legal mandates or through academic research projects. The Map entitled "Archaeological Site/Survey Locations" shows in blue the areas within the subarea that have been archaeologically surveyed. Some linear surveys are evident on the map, but most of the surveys shown near the river are a result of judgmental sampling of the river's terraces. Presented below is a breakdown of survey data by acreage and survey type including the percentage of the subarea that has been investigated.

Table 1. San Pedro Valley Subarea Survey Acreage By Survey Type

Survey	**Acreage**	**Percent of Subarea**
Linear	1,680	0.9
Block	4,256	2.4
Total	**5,936**	**3.3**

The total acreage figures indicate that more than 96 percent of the area has <u>not</u> been formally investigated. This limits what can be said about cultural resources in general and archaeological sites in particular. However, the San Pedro River Valley, its terraces and the adjacent bajadas have been the focus of considerable research, and much of it within the last ten years.

Archaeological research in the San Pedro Valley began in the 1950s when the University of Arizona recorded numerous Hohokam village sites north of the town of Mammoth; however it wasn't until the 1970s that full attention was given to the area. Testing and excavations of sites along the San Pedro produced large quantities of information on the Hohokam people who occupied the San Pedro Valley, and much of southern and central Arizona, between approximately A.D 700 and A.D. 1450. Extensive survey and test excavations conducted by the Center for Desert Archaeology in the 1990s has turned the San Pedro Valley into an archaeological laboratory where theories are being tested about the development of Hohokam culture and the interaction of the Hohokam with prehistoric Puebloan groups from the north and east

Site data: The following is a summary of archaeological data for the subarea that is presented by general time period and site function. The data have been broken down by the number of identifiable components or occupations, not by the number of sites per se. Since a site can be occupied more than once over time, the number of components is a more accurate reading of land use. This information uses data made available from the Arizona State Museum, University of Arizona, and the Center for Desert Archaeology in Tucson.

Table 2. San Pedro Valley Subarea Archaeological Site Data

Component	**Prehistoric**	**Historic**	**Total**
Agricultural	6	2	8
Communication	0	1	1
Habitation	25	6	31
Transportation	0	4	4
Other	0	1	1
Unknown	20	4	24
Total	**51**	**18**	**69**

As can be seen by this table, prehistoric components out number the historic components by almost three to one and habitation is the most common of the identifiable functions, followed by agricultural uses. This reflects a strong emphasis on agrarian settlement in the San Pedro subarea, particularly during prehistoric times. As is typical of archaeological site data anywhere, a large number of occupations cannot be assigned a function. This is because the data that are used here are collected during survey where only surface characteristics of sites are recorded without the benefit of excavation. The map entitled "Archaeological Site/Survey Locations" does not fully reflect the data presented in Table 2 due to incomplete entry of site data into the county's computerized database.

The next two tables tally the number of components within each of the two major time periods.

Table 2. San Pedro Valley Subarea Archaeological Site Data - Prehistoric Components (51)

PaleoIndian 9500 B.C - 5500 B.C	**Archaic** 5500 B.C- A.D 200	**E. Ceramic** A.D. 200- A.D. 700	**M. Ceramic** A.D. 700- A.D. 1150	**L. Ceramic** A.D. 1150- A.D. 1450	**Proto-Historic** A.D. 1540 - A.D. 1751
0	**2**	**1**	**30**	**14**	**4**

No occupations from the PaleoIndian time period are known with the subarea, although several sites dating to this time have been recorded in the San Pedro Valley further to the south. Only two components dating to the succeeding Archaic Period are known within the Subarea. During these ancient times, people are believed to have lived in small, highly mobile, bands by hunting and gathering wild plants and animals as food resources became seasonably available throughout the year. During the PaleoIndian Period, these bands appear to have favored hunting large game animals including mammoth, horse, camel, bear, and bison, all of which are now extinct. The environment became considerably warmer in the succeeding Archaic Period, the large game animals disappeared and were replaced by new plant and animal species. Human beings continued to hunt and gather their food but archaeological evidence suggests that they became more generalized in their diet and more efficient in processing their food. Towards the end of the period several significant changes began to occur. First, the environment stabilized by 4500 years ago approaching modern conditions. Second, population seems to have increased and some evidence suggests that people roamed within more circumscribed areas as a result. Third, by approximately 3500 years ago, people began to experiment with growing their own food. This change also co-occurred with more permanent settlement along well watered reaches of the Santa Cruz River and perhaps other regional drainages including the San Pedro.

The Ceramic Period covers the time in prehistory between the adoption of ceramic technology in the third and fourth centuries after Christ to the end of the Hohokam sequence around A.D 1450. Only one component dating to the Early Ceramic Period is known in the San Pedro Subarea. It was during this early time that Archaic Period populations made the transition from hunting and gathering to an agricultural based, village oriented existence in southern Arizona and elsewhere. By the time the Hohokam culture emerged in a recognizable form around A.D. 700, this commitment to an agricultural economy was complete. A total of 44 components have been identified as Hohokam in the San Pedro Subarea reflecting a sustained presence in the valley for over 700 years.

The Hohokam flourished along the rivers throughout the region and also adapted to the desert lands to the west. The Middle Ceramic Period is marked by settled village life based on agriculture that was supplemented by hunting and gathering. The Hohokam are known for their well executed pottery traditions, a distinctive style of arrowheads, ritual items such as sensors and carved stone pallets, as well as shell jewelry, to mention only a few examples of their material culture. Prior to about A.D. 1100, people lived in a variety of settlements ranging from small houses located near their fields, to hamlets consisting of a few houses, to large villages consisting of multiple groupings of house clusters, each representing families or extended families. Ritual appears to have played an important part of life and large oblong shaped depressions called "ball courts" were used providing social and political cohesion through ceremony, the exact nature of which is unknown. Thirty components dating to the Middle Ceramic Period, also known as the Hohokam "Pre-Classic Period" are known in the subarea, 10 of which are village occupations, and 8 are farmstead and field house occupations.

A lesser number of components by half are dated to the Late Ceramic Period or "Classic Period" in the Hohokam archaeological sequence. Fourteen such components are known in the Subarea. During the Late Ceramic Period from approximately A.D. 1150 - 145 0, mounded earthen platforms replace the ball courts as the center of religious life in the mai n villages. Housing style also changes from building houses in shallow pits with mud over wood and brush exteriors to above ground rooms built out of adobe, either as separate structures or in blocks of rooms. Frequently, these houses were surrounded by a low wall that defined the settlement as a separate compound consisting of related families. Subsistence continued to rely heavily on growing corn, beans, and squash, and just as in earlier times, large investments of labor were put into both irrigated agriculture and dry farming techniques. It is also at this time that the Hohokam began to intensively cultivate agave as a food source along the upper bajadas of the major rivers such as the Santa Cruz and the San Pedro. By the end of the Hohokam period, people had moved into a few, very large settlements. A period of environmental instability resulting in a series of floods in the A.D. 1300s appears to have weakened the agricultural economy to the point where the Hohokam were no longer able to produce food in sufficient quantifies and with enough consistency to support large populations. By A.D 1450, the large villages were abandoned and shortly thereafter the remaining people that archaeologists recognize as the Hohokam passed into human history.

Very little is known of the period following the collapse of the Hohokam and before the earliest entrance of the Spanish into the region in A.D. 1540. The Proto-Historic Period, marking the years between A.D. 1540 and the Pima Revolt in 1751 is equally murky, despite some written accounts, and sites dating to both times are very rare. The region appears to have been occupied by only a few people whose style of pottery, housing, and burial practices differed from the former Hohokam occupants reflecting a return to an earlier, simpler way of living. Life continued to involve the cultivation of crops supplemented by hunting and gathering, but the level of technical sophistication and social and religious cohesion characteristic of the Hohokam is missing in these later populations. The people who occupied the region are believed to be the descendants of the Hohokam who filled the vacuum left by their disappearance and emerged as the groups that in the San Pedro were known to the Spanish historically as the Sobaipuri, and to the west of the Santa Cruz River, the Tohono O'odham. No components dating to late prehistoric times are known in the San Pedro subarea. Four Proto-Historic Native American components have been identified, two of which are identified as farmsteads as indicated in Table 4.

Table 4. San Pedro Valley Subarea Archaeological Site Data - Historic Components (Post A.D 1540)

Euro-American	Native American	Unknown	Total
10	**4**	**1**	**13**

European occupation of the San Pedro dates primarily to the mid to late 19th century. A total of 10 such components have been identified in the subarea dating to this time period, four of which are habitations, four are transportation (roads, trails, stage stops, etc.) related features and one is related

to communication functions (cairn, telegraph/telephone line, monument etc). There is also one component that could not be securely identified as to cultural affiliation. In the past, researchers have generally not focused on the historic period as a subject of archaeological interest and the low number of components recorded on sites dating to this time period reflects this bias.

Historical Resources

Historical resources are sites, districts, structures, objects, or other evidences of human activities that represent facets of the history of the nation, state, or locality. Also pl aces where significant historical or unusual events occurred even though no evidence of the event remains, or places associated with persons significant in our history that have gained importance in the last 50 years.

Historical resources are largely constructed or engineered elements of the built environment including buildings used for residential purposes such as houses but also commercial stores, industrial facilities, civic centers, and places of worship. Roads, bridges, irrigation canals, mining works, and rail road tracks are also historical resources . Information on these places is recovered through drawings and design plans, photographs, maps, surveys, and personal recollections.

Redington is a historic community that contains buildings that may have historic value, and may also contain historic archaeological deposits dating to the end of the last century and the beginning of the 20th century. Redington was settled as a result of a post office being opened by Henry and Lem Redfield in 1875 at their ranch located approximately six miles south of the present town. Lem Redfield was hung by a mob at Florence in 1883 for allegedly participating in a stage robbery that resulted in a murder. They wanted a post office, but th e post office would not allow the use of their name, so they used "Redington." In 1879, the post office was formally established by Henry Redfield.

There may also be individual ranches or farmsteads within the subarea that qualify as having importance to the history of the settling of the San Pedro River Valley. Some of these may be part of larger historic landscapes that are recognizable entities that have historic value. Historic Landscapes a special subcategory of historic resources. As defined by the National Park Service, a rural historic landscape is "that portion of the exterior natural environment that has been modified, influenced, or given special cultural meaning by people who shaped the landscape to serve human needs. A rural historic landscape is a geographical area that historically has been used by people or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways and natural features. Historic landscapes may reflect the beliefs, attitudes, traditions, and values of these people."

Traditional Cultural Places

A traditional cultural place is a historic site or district that is important because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the con tinuing cultural identity of the community. The

traditional cultural significance of an historic property is derived from the role the property plays in a community's historically rooted beliefs, customs, and practices.

Pima County has been occupied by indigenous peoples for thousands of years and the modern descendants of these prehistoric cultures still live in the region today. All of Pima County is claimed as ancestral lands by the Ak-Chin Indian Community, the Gila River Indian Community, and the Tohono O'odham Nation. The Tohono O' odham claim direct ancestral affiliation with the prehistoric Hohokam Indians who inhabited much of southern and central Arizona. Other Indian groups also claim ancestral ties to the Pima County area including the Zuni of central western New Mexico and the Hopi of northeastern Arizona based on both a recognition of prehistoric archaeological sites as ancestral and based upon oral histories and myth that identify southern Arizona as a place of origin for these tribes. The Apaches also lived in the region for hundreds of years and therefore they too can claim an ancestral connection to the land and the places of traditional value to them that it may contain.

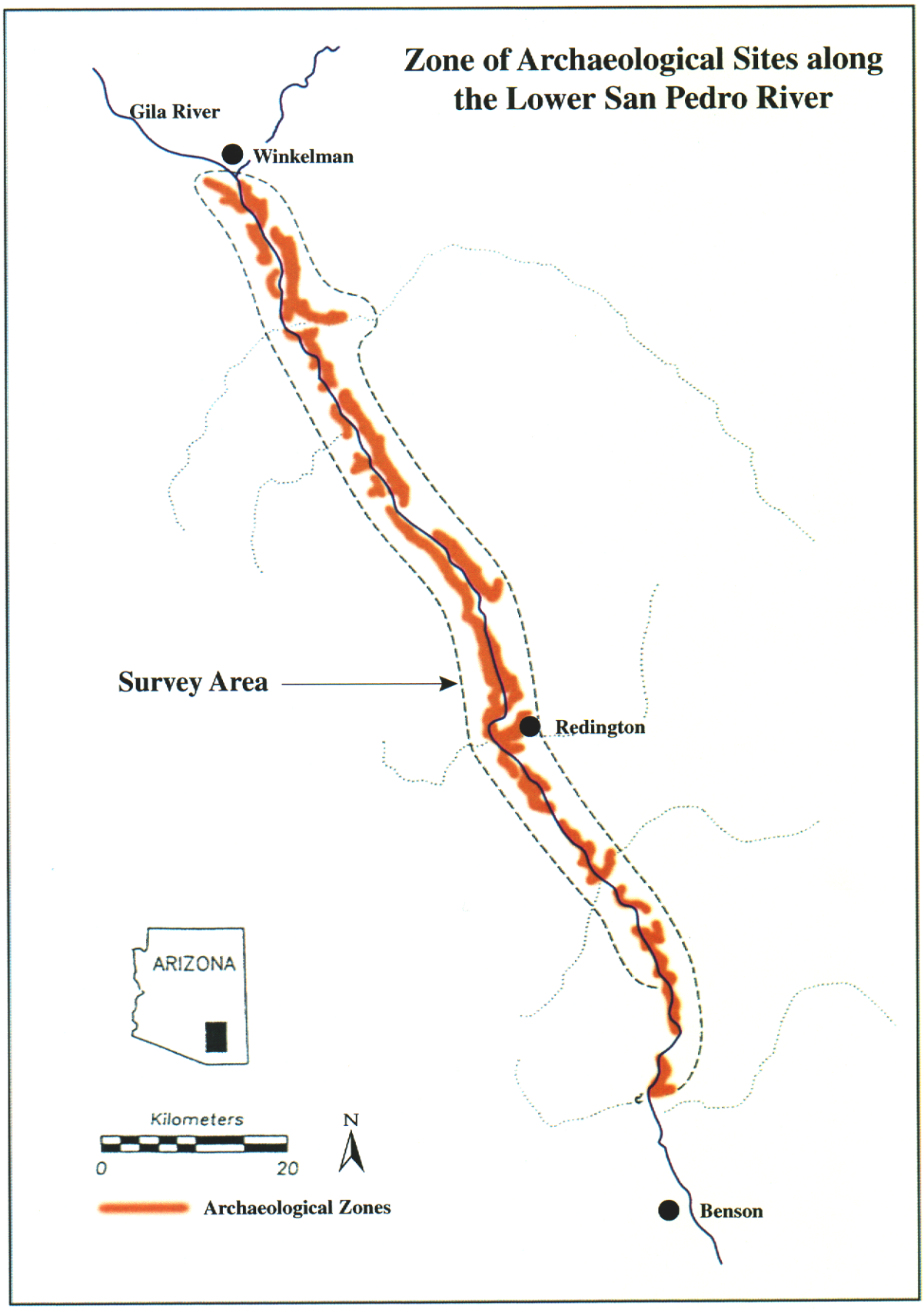
Places of traditional cultural value, as defined, are special to the community and must often remain secret to non-members; there are no specific traditional cultural places recorded in the San Pedro Subarea. This, however, does not mean they don't exit. These might be places where in the past natural resources were collected for ceremony or where natural features on the landscape are still recognized as having significance. Native Americans in particular identify prehistoric rock art sites and all archaeological sites containing human graves as having qualities that make them recognizable as traditional cultural places. Habitation sites often contain graves and since there are 25 components in the subarea used for habitation, it is reasonable to assume that Native Americans would identify these places as having traditional cultural value.

Summary

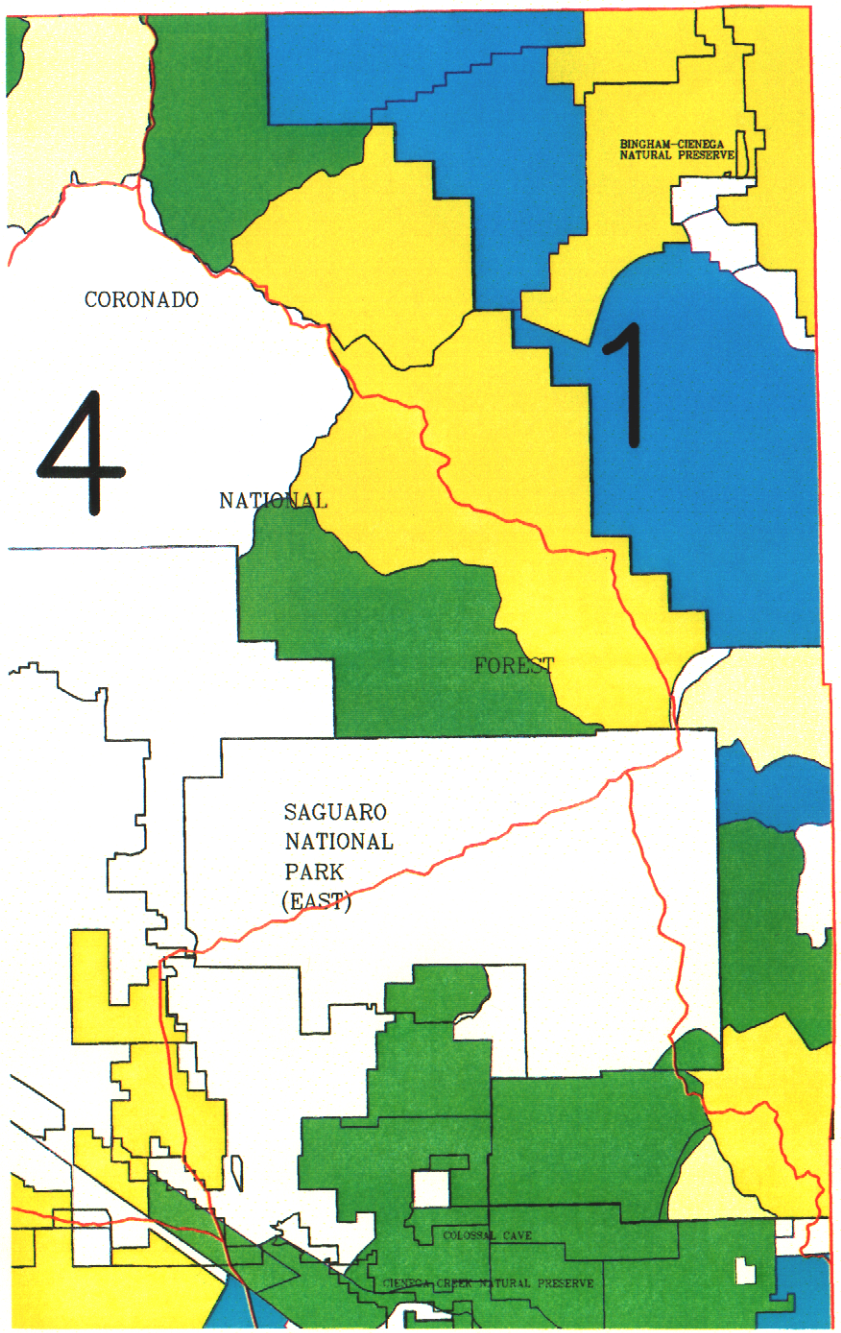
By far the most common cultural resource known with the San Pedro Subarea is archaeological, of which the majority are prehistoric sites and components. To illustrate the point, the attached map prepared by the Center for Desert Archaeology in Tucson shows the distribution of archaeological sites within the Lower San Pedro, including the subarea; this clearly demonstrates the richness of the flood plain and adjoining river terraces. As of 1997, a total of 559 archaeological sites were recorded in the area between Benson and Winkelman. The San Pedro Subarea, which encompasses the valley floor and Buehman Canyon on the west and Redfield Canyon on the east, has been a focal point for human occupation for over 1200 years dating from at least A.D. 800 to the present day. This area has a large number of relatively undisturbed archaeological sites that have high scientific and educational value. Redington is a historic community that is a product of 19th century frontier settlement with potential archaeological and architectural assets. Lastly, Native American claims identify the San Pedro as part of their traditional use areas and so the possibility that places with traditional cultural value exist in the subarea is high, especially those places associated with the archaeological record. In short, the subarea is rich in cultural and historical resources value.

In effort to predict the locations of areas with high sensitivity for cultural and historical resources,

proximity to water is used under the assumption that places closer to water will tend to have been used more heavily by past human populations than places more removed from water sources. The map entitled "One Mile Buffer (around) Springs and Major Washes identifies areas within the subarea that are predicted to be highly sensitive for cultural resources. These areas include springs in the subarea, almost all of which are located in the foothills of the Santa Catalina and Rincon Mountains and the San Pedro River drainage, an area known to have been the primary focus of human occupation for several thousand years.


Zone of Archaeological Sites along the Lower San Pedro River
Gila River
Winkelman
Survey Area
Redington
Benson
ARIZONA
Kilometers
0
20
N
Archaeological Zones

Carrying Capacity per Square Mile by Grazing Allotment

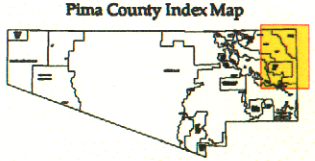


SDCP PLANNING UNIT 1
San Pedro

- Administrative Boundaries
- Grazing Allotment
- Planning Boundary

- Not Grazed
- 1 to 3 AUs
- 4 to 6 AUs
- 7 to 9 AUs
- 10 to 12 AUs
- 13 to 15 AUs
- 16 or greater AUs

Pima County Index Map



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N

Scale 1: 67,000

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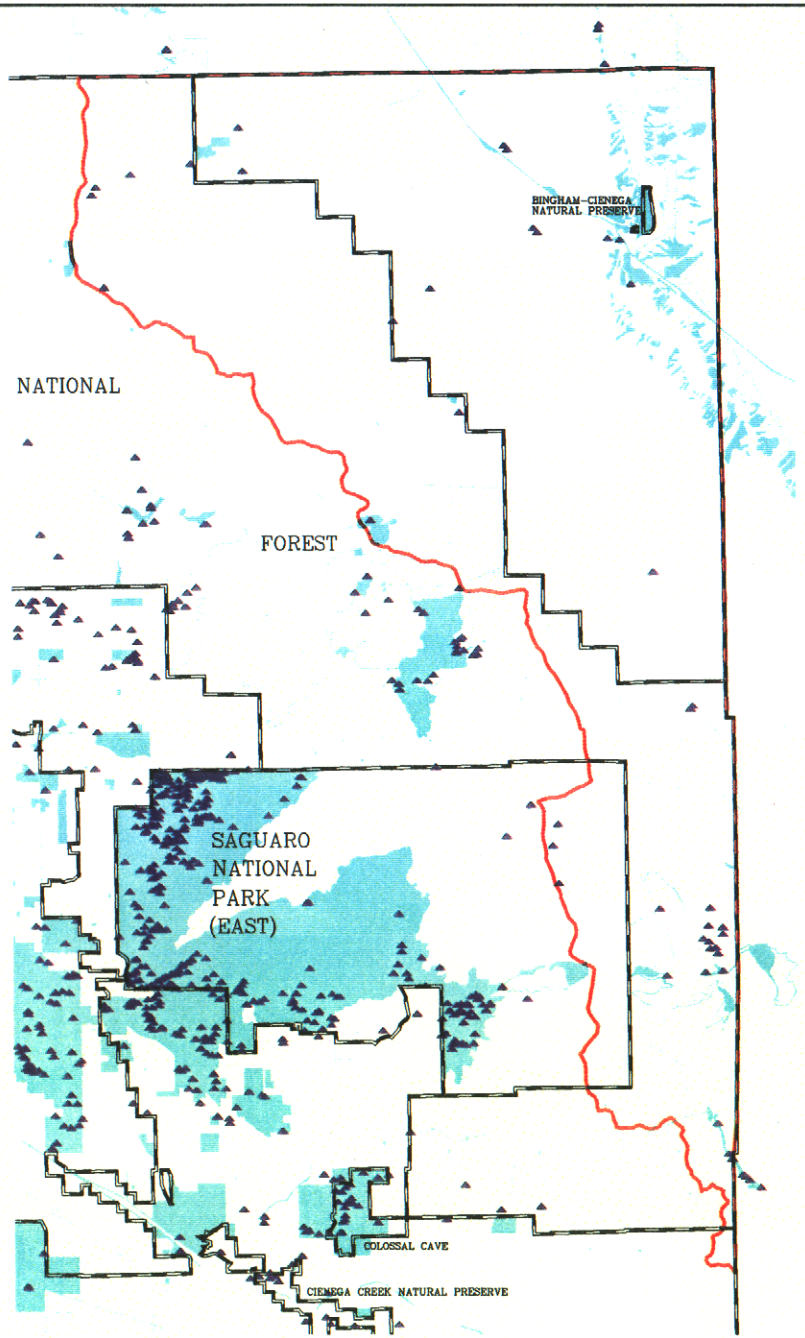


Archaeological Site/Survey Locations

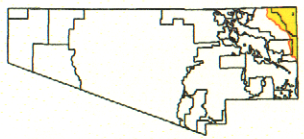
SDCP PLANNING UNIT 1

Archaeology Surveys

Archaeology Sites

STATISTICS
****
TOTAL NUMBER OF SITES: 40
AREA FOR POLYGONAL SURVEYS: 4,256.40 AC
LENGTH FOR LINEAR SURVEYS : 487,921.10 FT
92.41 MI

Pima County Index Map



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03/02/00

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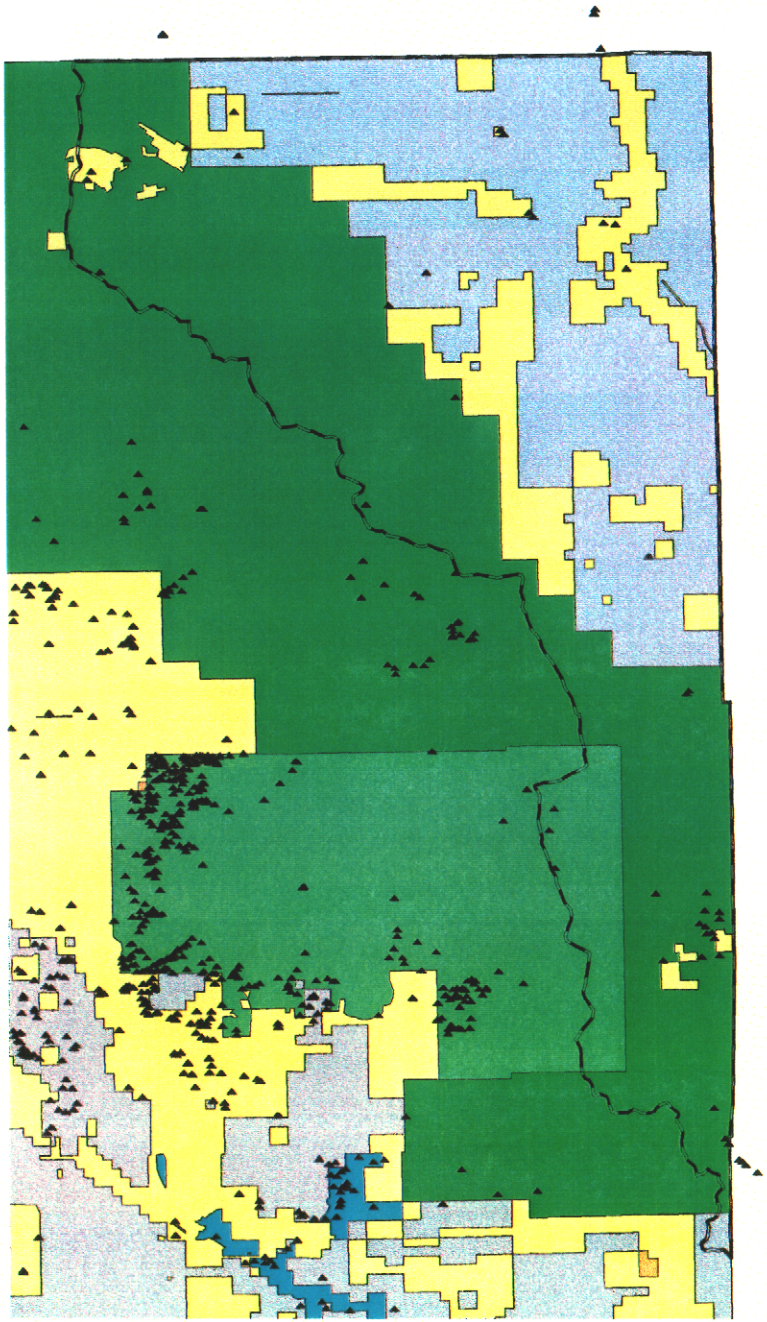


Archaeological Sites and Land Ownership

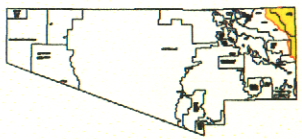
SDCP PLANNING UNIT 1

- Watershed Planning Boundary
- Archaeology Sites
- BLM
- COUNTY PARKS
- INDIAN LANDS
- GOLDWATER GUNNERY RANGE
- MILITARY RESERVATIONS
- NATIONAL FOREST LANDS
- NATIONAL PARKS AND MONUMENTS
- NATIONAL WILDLIFE REFUGE
- PRIVATE LANDS
- STATE LANDS
- STATE PARKS

ARCHAEOLOGY SITES BY LAND MANAGEMENT

JURISDICTION	# OF SITES
BLM	0
COUNTY PARK	0
GOLDWATER GUNNERY RANGE	0
INDIAN LANDS	0
MILITARY RESERVATIONS	0
NATIONAL FOREST LANDS	23
NATIONAL PARKS AND MONUMENTS	3
NATIONAL WILDLIFE REFUGE	0
PRIVATE LANDS	8
STATE LANDS	6
STATE PARKS	0
COUNTY OWNED LAND	0
TOTAL	40

Pima County Index Map



Index Map Scale 1:1,500,000

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Scale 1: 70,000

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/pygayow12/sonora/cultural/aamjoined/plan1/aals/park1.aml Plotted 3/01/00

Sonoran Desert Conservation Plan

San Pedro Watershed Sub-area Report

Draft

Pima County

March 2000

TABLE OF CONTENTS

I. SUMMARY

The San Pedro Watershed sub-area lies in the north-eastern corner of Pima County, east of the Coronado National Forest and the Saguaro National Park (east), including parts of both preserves. Land ownership is comprised primarily of State Trust Land.

The current land use on private lands is agricultural and ranching activities. Except for the natural preserves, the entire watershed is zoned RH, Rural Homestead. There are no planned land uses.

The topography in the San Pedro Valley range in altitudes between 900 and 2,600 meters above MSL, with prominent mountain peaks and ridges on both the east and west. The mountain ranges of the Santa Catalina and Rincon flank its west. The ranges of the Galiuro, Winchester and Little Dragoon mountains, all in Cochise County, lie to its east.

The perennial and intermittent streams in the San Pedro watershed are: Atchley Canyon, Bear Canyon, Buehman Canyon, Bullock Canyon, Burro Wash, Edgar Canyon, Espiritu Canyon, Miller Creek, Roble Canyon, parts of the San Pedro River, Sycamore Canyon and Youtcy Canyon. An approximate area of six miles by one mile, close to the northern section of the San Pedro River, is "suspected" of having shallow ground water. The general area also has about a dozen wells with depth to water measuring less than 50 feet.

The San Pedro Valley watershed has low-densities of population and housing, owing to its predominance of vacant land and natural preserves.

The vegetation includes alder, Arizona ash, Arizona sycamore, Arizona walnut, emory, fremont cottonwood, hackberry tree, juniper, mesquite, oak and willow, along the various canyons and creeks in the area.

The Santa Catalina and Rincon Mountains are to the west and the Galiuro and Winchester Mountains are to the east, that create panoramic landscapes across the pristine valley.

Originating with Tanque Verde Road, Redington Road provides access east from metropolitan Tucson to the Redington area across the Santa Catalina and Rincon Mountains. The Redington School District, which is a "transporting district", covers the northeastern corner of Pima County (Redington area). This district does not have a school in the area; the children are bussed to Pinal County to San Manuel's schools which include an elementary, a middle, and high school.

There are no capital improvement projects underway but a parks and recreation project, the Bingham Cienega, proposed for FY 2004, with a budget of $1,000,000.

II. SITE INVENTORY AND ANALYSIS

A. Location

The San Pedro Watershed sub-area lies in the north-eastern corner of eastern Pima County, east of the Coronado National Forest and the Saguaro National Park (east). The northeastern fringe of the Coronado National Forest extending down to the Rincon Valley and the eastern portion of the Saguaro National Park (west) lie within the watershed. It encompasses a land area of approximately 174,315 acres.[1]

B. Ownership

Land ownership is comprised primarily of State Trust Land. Others include the reserves of the Coronado National Forest, Saguaro National Park (east), county land and private land. Of the private land, most of it is ranch property.

C. Land Use and Zoning

1. Land Use

The current land use for the sub-area is predominantly vacant land, mostly property that belongs to the State Land Trust. The area is very rural in nature, with low densities of development, separated from the rest of the County by the Coronado National Forest. Land use on private land is primarily ranch properties. With the exception of the public preserves and the currently vacant land, the predominant land use type is agricultural, as shown in **Table 1**.

Table 1

EXISTING LAND USE--UPPER SAN PEDRO WATESHED		
LAND USE	**JURISDICTION**	**ACRES**
RURAL	PIMA COUNTY	398.29
0.2 TO 0.4 RAC	PIMA COUNTY	6.79
0.4 TO 0.75 RAC	PIMA COUNTY	8.00
AGRICULTURAL	PIMA COUNTY	15,874.74
COMMERCIAL	PIMA COUNTY	958.05
INDUSTRIAL	PIMA COUNTY	391.18
PUBLIC PRESERVE	PIMA COUNTY	84,088.49
VACANT	PIMA COUNTY	67,934.00
VACANT-JUR	PIMA COUNTY	2,260.20
CHK	PIMA COUNTY	2,312.18

Currently, there are no planned land uses designated for properties in the watershed. The natural preserves have their designations.

2. Zoning

The portion of the watershed that lies within Pima County, excluding the public preserves, is zoned RH Rural Homestead, which equals approximately 91,000 acres.

3. Housing

The existing land use reveals that mobile homes and single family residences account for all of the housing. These residential uses occur in the northeast corner of the watershed, covering a total area of approximately 600 acres, as shown in **Table 2**.

Table 2

NO.	EXISTING LAND USE (HOUSING)	ACREAGE
1.	Single Family	330.74
2.	Mobile homes	267.02

D. Topography

The sub-area topography, like most of Pima County watersheds, reflects two distinct feature types. The northwestern portion of the San Pedro Valley, which lies within Pima County, has altitudes that range between 900 and 1,300 meters above the mean sea level (MSL); and, the distinct peaks and ridges of the Santa Catalina Mountains to its southwest and the Rincon Mountains to its south vary in altitude between 1,300 and 2,600 meters above MSL.

Table 3

MOUNTAINS	PEAKS	ALTITUDE (METERS)*	LOCATION
SANTA CATALINA	Oracle Ridge	2,345	T11S, R16E
	Marble Peak	2,330	T11S, R16E
	Lombar Hill	1,900	T11S, R16E
	Butterfly Peak	2,244	T11S, R16E
	Mount Bigelow	2,561	T12S, R16E
	Green Mountain	2,409	T12S, R16E
	Evans Mountain	1,700	T11S, R17E
RINCON	Mica Mountain	2,600	T14S, R18E
	Reef Rock	2,600	T14S, R18E
	Rincon Peak	2,585	T15S, R18E

* Highest point of any given peak (within watershed)

The valley begins in southeastern Pinal County and stretches into Cochise County. The mountain ranges of the Santa Catalina and Rincon flank its west. The ranges of the Galiuro, Winchester and Little Dragoon mountains, all in Cochise County, lie to its east. **Table 3**, lists some of the prominent peaks of the mountain ranges of the San Pedro Valley, within Pima County.

The valley has several canyons and passes. The prominent ones, that lie within Pima County, on the northeastern slopes of the Santa Catalina and Rincon Mountains, are listed in **Table 4**.

Table 4

CANYON	AVG. ALTITUDE	LOCATION	PROXIMITY
Alder	1,400	T11S, R16-17E	NE of Santa Catalina Mountains
Atchley	1,400	T11S, R16E	NE of Santa Catalina Mountains
Bolt	1,200 - 1,400	T13S, R18E	N or Rincon Mountain Wilderness
Buehman	1,000 - 1,200	T12S, R17-18E	W of San Pedro River
Bullock	1,000 - 1,200	T12S, R17E	NE of Chimney Rock
Burro	1,300 - 1,500	T12S, R17E	E of Guthrie Mountain
Cumaro	1,200 - 1,400	T16S, R18E	E of Rincon Mountain Wilderness
Edgar	1,000 - 1,100	T11S, R17-18E	NE of Evans Mountain
Espiritu	1,100 - 1,200	T13S, R18E	NE of Tucson Mountain Wilderness
Happy Valley	1,200	T15S, R18E	NE of Rincon Peak
Joaquin	1,200 - 2,000	T13-14S, R17-18E	N of Saguaro National Monument
Mesquite	1,300 - 1,500	T14S, R18E	E of Saguaro National Monument
Miller	1,300 - 1,500	T15S, R18E	E of Saguaro National Monument
Peck	800 - 1,000	T11S, R18E	S of Pinal/Pima County Boundary
Tres Pipas	1,200 - 2,000	T13-14S, R18E	E of Saguaro National Monument
Youtcy	1,000 - 1,200	T13S, R18E	E of Chimney Rock

E. Hydrology

In Pima County, the water problems evident today stem from historic issues of: serious overdraft of an aquifer due to continued groundwater mining; the failure to understand the interconnection between surface and ground water; and "the continued strategies within the community to defer reconciliation of water use with water availability."[2] These in turn have given rise to "the loss of 85 to 95% of quality riparian habitat during the last century,..."[3] It is evident that "the jurisdictions throughout the region face the realistic prospect that a level of restoration will be a condition of the Section 10 permit issued under the Endangered Species Act."[4]

The perennial and intermittent streams in the San Pedro watershed are: Atchley Canyon, Bear Canyon, Buehman Canyon, Bullock Canyon, Burro Wash, Edgar Canyon, Espiritu Canyon, Miller Creek, Roble Canyon, parts of the San Pedro River, Sycamore Canyon and Youtcy Canyon.[5] At the north-eastern part of the watershed, an approximate area of six miles by one mile, close to the northern section of the San Pedro River, is "suspected" of having shallow ground water.[6] The general area also has about a dozen wells with depth to water measuring less than 50 feet (ADWR Well 55-Registry and GWSI databases, as mentioned in the above-referenced report).[7] The list of suspected shallow groundwater areas include Buehman Canyon, Bullock Canyon, Burro Canyon, Edgar Canyon, Espiritu Canyon, Miller Canyon and Turkey Creek.[8]

Over 90 percent of the land in the watershed is either vacant or falls within public preserves. The low levels of development have made minimum demands on water.

F. Environmental Characteristics

1. Vegetation

Vegetation such as Arizona sycamore, mesquite, juniper, hackberry tree, Arizona ash and Arizona walnut have been identified along the Bullock Canyon; Arizona sycamore, fremont cottonwood, Arizona ash, hackberry tree, emory oak and mesquite along Miller Canyon; sycamore, ash, alder, willow, oak and juniper along Sycamore Canyon; and, Arizona sycamore, hackberry tree and Arizona ash have been identified along the Turkey Creek.[9]

The watershed is documented to have these flora based on the Gap Analysis Program (GAP). GAP is "a national endeavor to catalog the range of vertebrates or their habitat (based on vegetation) in every state and compate them to land ownership."[10] The vegetation types include Chihuahuan Desertscrub (Creosotebush - Tarbush), Chihuahuan Desertscrub (Mixed Scrub), Sonoran Desert Scrub (Paloverde - Mixed Cacti), Sonoran Desert Scrub (Creosotebush - Bursage), Sonoran Deciduous Swamp and Riparian Scrub (Mixed Scrub), Sonoran Riparian and Oasis Forest (Cottonwood - Willow), Madrean Evergreen Forest (Encinal), Madrean Evergreen Forest (Oak - Pine), Madrean Montane Conifer Forest (Douglas Fir - Mixed Conifer), Mogollon Chaparral Scrubland (Mixed Evergreen Sclerophyll) and Mogollon Chaparral Scrubland (Manzanita).[11]

2. Wildlife

Please refer to the report on Biological Resource Base and *Water Resources and the Sonoran Desert Conservation Plan*, July 1999.

G. Viewsheds

The San Pedro River Valley, with its natural preserves, ranches and vast expanses of land allows for spectacular views all around. The Santa Catalina and Rincon Mountains are to the west and the Galiuro and Winchester Mountains are to the east, that create panoramic landscapes across the pristine valley.

H. Infrastructure

The San Pedro watershed has the lowest of development densities when compared with the other watershed sub-areas. The predominance of vacant land, ranches and natural preserves (Coronado National Forest and Saguaro National Park - ease) has placed minimum demands on infrastructure.

1. Roads & Access:

Originating with Tanque Verde Road, Redington Road provides access east from metropolitan Tucson to the Redington area (central to the Middle San Pedro watershed) where Redington Road intersects with San Pedro River Road and Benson-Mammoth Highway. From Redington, San Pedro River Road is a northwest route towards Pinal County and the communities of Mammoth and San Manuel. Benson-Mammoth Highway, which at one time was a state route, provides access to the southeast towards Cochise County, Benson and Pomerene. Redington Road is a dirt road that is county-maintained, at least as far as one mile into the Coronado National Forest boundary. San Pedro River Road and Benson-Mammoth Hwy are both county-maintained, dirt roads. There are no county maintained, paved roads in the area. According to the Pima County Major Streets and Scenic Routes Plan, Redington Road and San Pedro River Road* are designated "Scenic and Major" routes with special zoning regulations for abutting properties. Redington Road has a planned right-of-way (per the Major Streets and Scenic Routes plan) of 150 feet. Redfield Canyon Road is also a county-maintained, dirt road. Dirt roads in the area that are not maintained by the county include Bellota Ranch Road, Six Bar Ranch Road, and several that are unnamed.

[* The Major Streets and Scenic Routes Plan identifies what is, in actuality, both Redington Road and San Pedro River Road, as only Redington Road.]

2. Water:

According to the Department of Water Resources, this area is outside of the Tucson Active Management Area and is served by private wells.

3. Sanitary Sewer:

There are no plans for any sanitary sewers in the San Pedro watershed. The Waste Water Department has no facilities currently and there are no known plans for any in the future.

4. Natural Gas:

The area is served by private, propane tanks; Southwest Gas currently has no lines in the area.

5. Telephone & Electricity:

U.S. West serves the areas around San Manual, including this area. APS Energy Services provides electrical service to the Redington area. Trico Electric company serves the Mt. Lemmon community.

6. Schools:

The Redington School District, which is a "transporting district", covers the northeastern corner of Pima County (Redington area). This district does not have a school in the area; the children are bussed to Pinal County to San Manuel's schools which include an elementary, a middle, and high school. Any children of private, residential holdings on the south side of the Rincon Mountains would likely attend the Vail Unified School District facilities. The Vail Unified School District has three elementary schools (Acacia, Desert Willow, Mesquite), one middle school (Old Vail Middle School), and one preschool (Old Vail Preschool). High school students within the Vail Unified School District area are now bussed to other district high schools including Sabino High School. A new high school for the Vail Unified School District is planned. The State Department of Education also lists Vail Charter High School which is located on South Rita Road.

7. Parks:

There are no county parks within this area. The Coronado National Forest (Rincon and Catalina Mountains) and the Saguaro National Park are the southwestern boundary of the watershed area.

I. Open Space

The primary open spaces in the watershed are the preserves. Studies were done where "reserve boundaries were verified by land managers, ..."[12] The reserves identified within the watershed are the Bingham Cienega Natural Preserve, Buehman Canyon, Coronado National Forest,Rincon Mountain Wilderness, Saguaro National Monument - East.[13]

Table 5

NO	RESERVE	ACRES (APPROX).	LOCATION
1.	Bingham Cienega Natural Preserve	285	T11S, R18E
2.	Buehman Canyon	2,800	T12S, R18E
3.	Coronado National Forest	-	**
4.	Rincon Mountain Wilderness	-	**
5.	Saguaro National Monument	-	**

** Parts of the preserves lie within the watershed, therefore their acreages and location are very general

J. Archaeological and Cultural Resources

Please refer to *Pima County's Cultural and Historic Resources* Report.

K. Real Estate Market Conditions

The land use activities and densities of development are very low. The potential for future development at higher densities are not likely. This is partly due to the lack of easy access across the Rincon and Santa Catalina Mountains and the only current land use activity of ranching. The revenue generated in this watershed is very low.

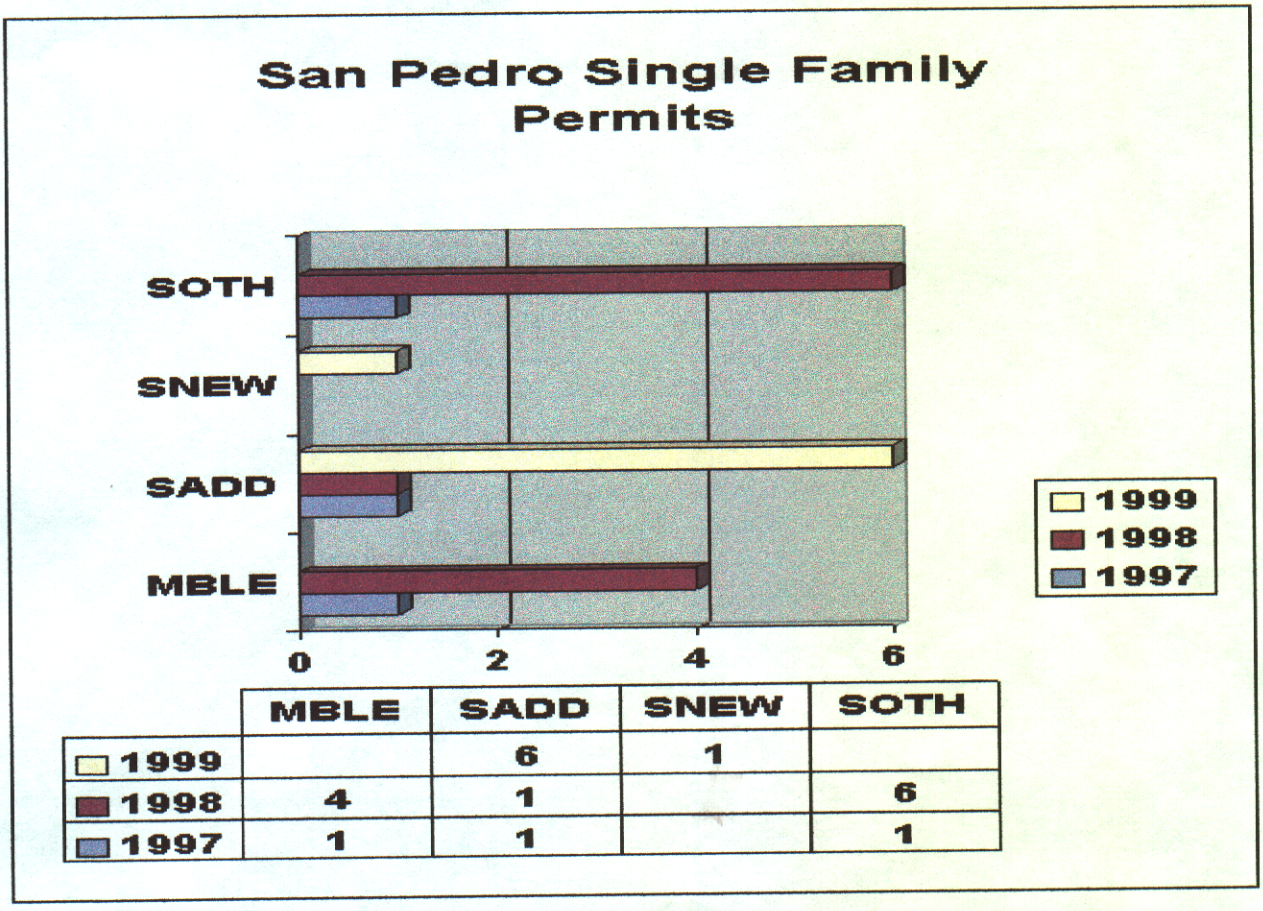
L. Capital Improvement Project (by Departments)

Currently, there are no improvement projects underway. There is one parks and recreation project, the Bingham Cienega, RW-13, proposed for FY 2004, with a budget of $1,000,000.

M. Permits

Permits issued for residential and commercial activities, between 1997 and 1999, are shown in **Graph 1** and **Graph 2**.

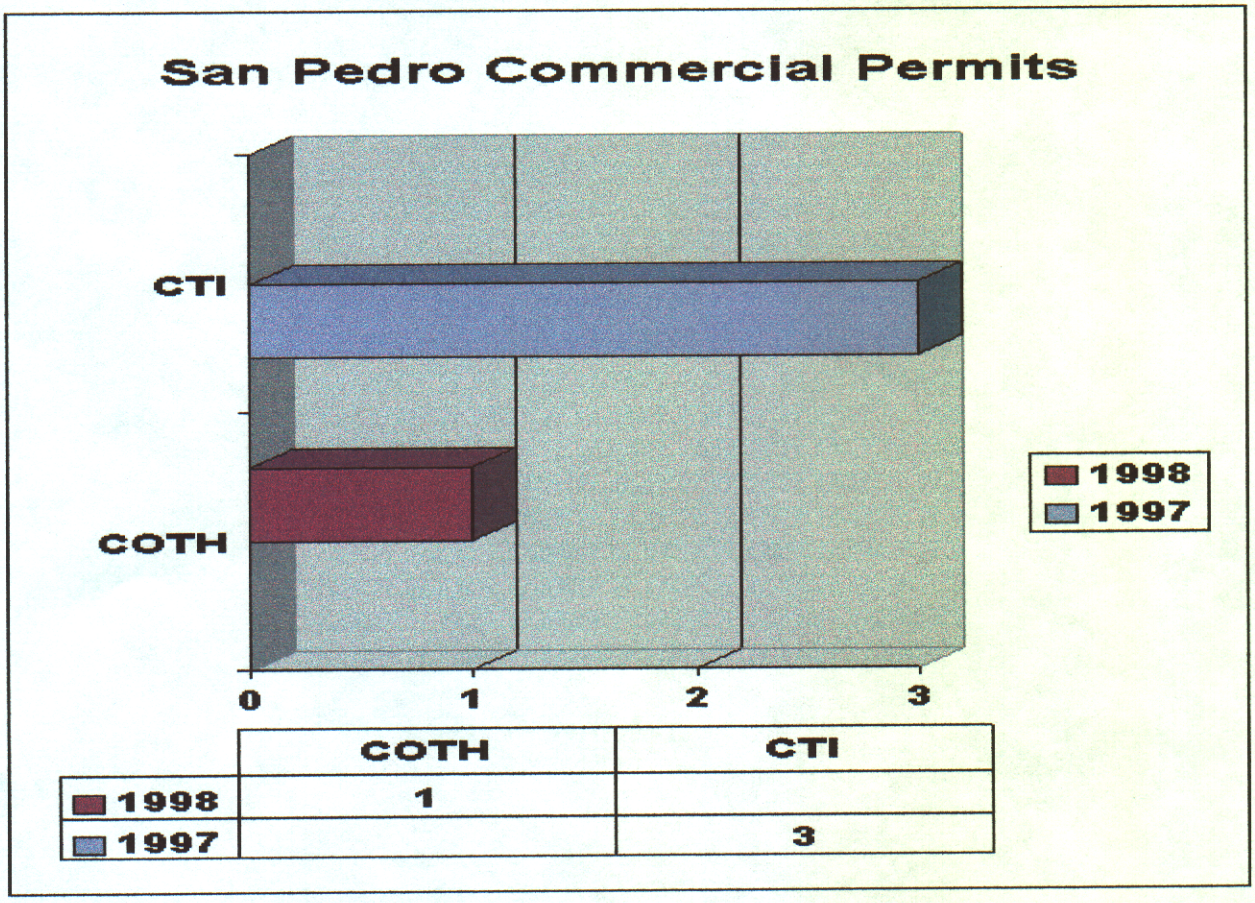
Graph 1



	MBLE	SADD	SNEW	SOTH
1999		6	1	
1998	4	1		6
1997	1	1		1

MBLE = Mobile Homes; SADD = Single Family Additions; SNEW = New Single Family Homes; SOTH = Single Family (Other)

Graph 2



COTH = Commercial (Other); CTI = Commercial Tenant Improvement

APPENDICES

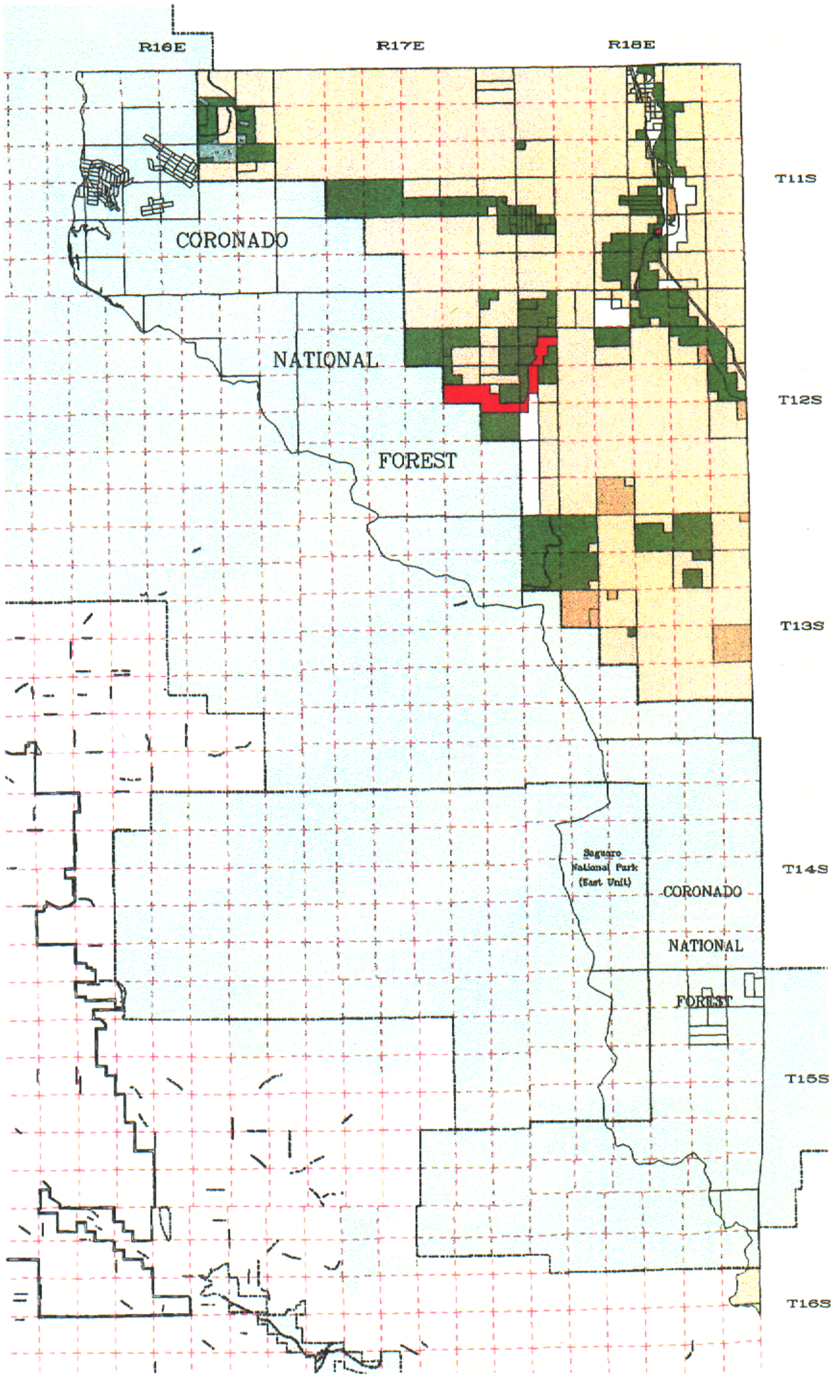
Maps

1. Existing Land Use Map
2. Existing Zoning Map

EXISTING LAND USE

Upper San Pedro Watershed

06-MAR-2000



Legend

Existing Land Use

- VACANT
- RURAL
- 0.2 TO 0.4 RAC
- 0.4 TO 0.75 RAC
- 0.75 TO 1.25 RAC
- 1.25 RAC TO 3.0 RAC
- 3.0 TO 6.0 RAC
- 6.0 TO 10.0 RAC
- 10.0 TO 15.0 RAC
- 15.0 TO 25.0 RAC
- GREATER THAN 25 RAC
- LODGING
- RESORT
- OFFICE
- COMMERCIAL
- PRIVATE STREETS
- INDUSTRIAL
- INSTITUTIONAL
- MISC. GOVERNMENT
- TRANSPORT FACIL
- UTILITIES/ TELECOMMUNICATIONS
- PARK
- GOLF COURSE
- AGRICULTURE
- DEDICATED OPEN SPACE
- OTHER
- MILITARY/ST. POLICE
- VACANT-STATE
- VACANT-JURISDICTION
- PARTIALLY DEVELOPED
- NO DATA

Basemap Features

- Public Preserves
- Tribal Lands
- Public Preserve Boundary
- City and Town Limits
- Sections

This map is regional in nature. Data comes from many sources, including the Pima County Development Services Dept, Dept. of Transportation and the Pima County Assessor's Office.

PLAN COORDINATION:
Pima County Development Services Department
Planning Division - Comprehensive Plan Section
201 N. Stone Ave.
Tucson, Arizona 85701
520 740 6800

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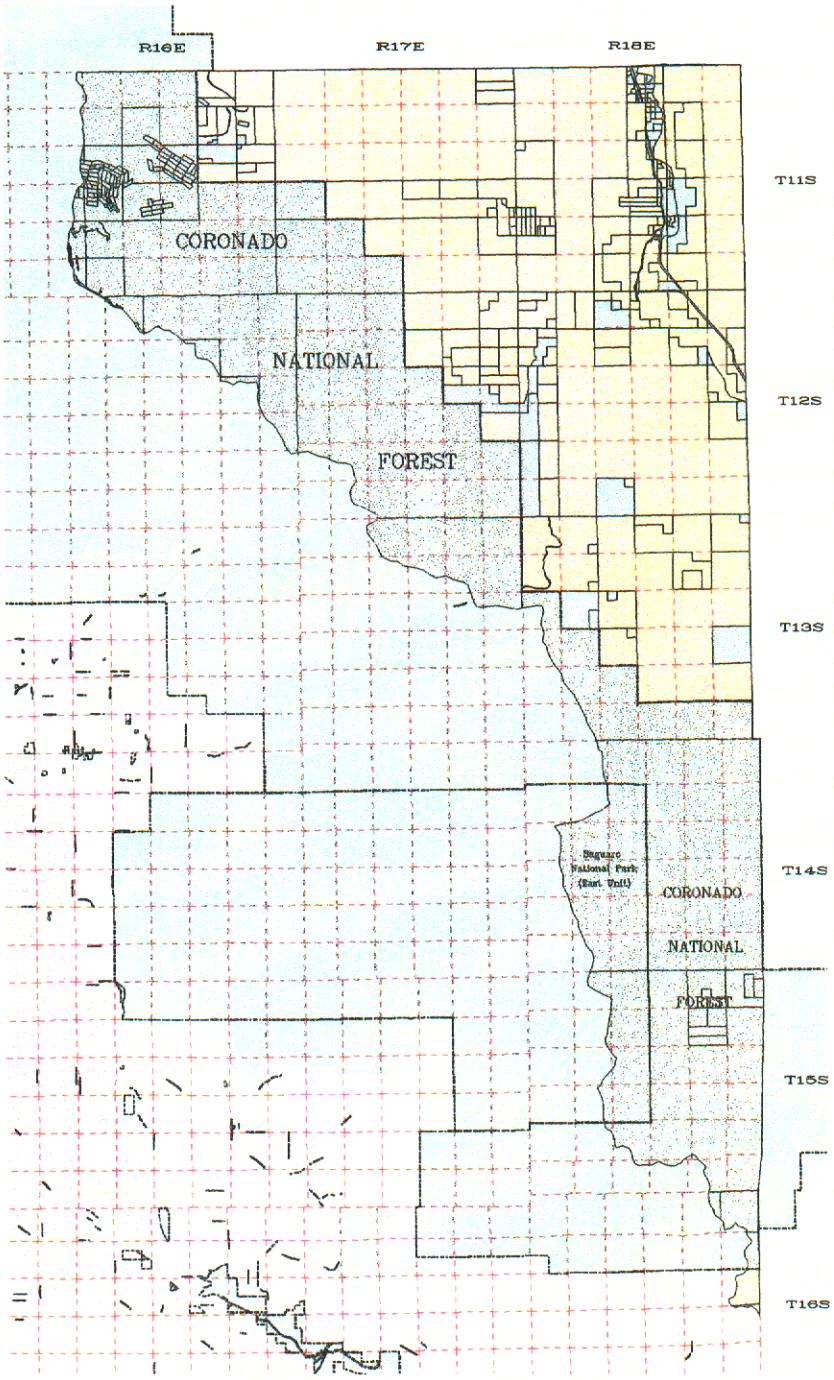

EXISTING ZONING
ON VACANT LAND
Unincorporated Pima County
Upper San Pedro Watershed
06-MAR-2000

Legend

Zoning Districts

- IR Institutional Reserve
- RH Rural Homestead
- GR-1 Rural Residential
- SR Suburban Ranch
- SR-2 Suburban Ranch Estate
- SH Suburban Homestead
- CR-1 Single Residence
- CR-2 Single Residence
- CR-3 Single Residence
- CR-4 Mixed Dwelling Type
- CR-5 Multiple Residence
- TR Transitional
- CMH-1 Mobile Home 1
- Cond'l Zoning Boundary
- CMH-2 Mobile Home-2
- TH Trailer Homesite
- MU Multiple Use
- MR Major Resort
- RVC Rural Village Center
- CB-1 Local Business
- CB-2 General Business
- CPI Campus Park Industrial
- CI-1 Light Industrial/Warehouse
- CI-2 General Industrial
- CI-3 Heavy Industrial
- SP Specific Plan
- GC Golf Course

CB-1

Basemap Features

- Built or Committed Land
- Cities and Towns
- Sections
- Public Preserve Boundary
- Public Preserves
- Tribal Lands

Note: Vacant land shown by zoning district color

This map is regional in nature. Data comes from many sources, including the Pima County Development Services Dept, Dept. of Transportation and the Pima County Assessor's Office.

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Archo2\projects\comm2\mxd\zone_ep.mxd

MAP

REFERENCES

Pima County/Pima Association of Governments. *GIS Coverages of Perennial and Intermittent Streams, and Areas of Shallow Groundwater, Sonoran Desert Conservation Plan.*

Pima County. *Land Stewardship in Pima County, Sonoran Desert Conservation Plan.*

Pima County. *Sonoran Desert Conservation Plan, Focus on Riparian Areas.*

Pima County. *Water Resources and the Sonoran Desert Conservation Plan.*

USGS. Tucson, ARIZONA. *30 X 60 Minute Quadrangle.*

END NOTES

1. Pima County, *Land Stewardship in Pima County, Sonoran Desert Conservation Plan*, February 2000, Table 6, p. 14.
2. Pima County, *Water Resources and the Sonoran Desert Conservation Plan*, July 1999, p. ii.
3. Ibid, p. 3.
4. Ibid.
5. Pima Association of Governments for Pima County, *GIS Coverages of Perennial and Intermittent Streams, and Areas of Shallow Groundwater, Sonoran Desert Conservation Plan*, January 2000, Table 3, Table 4 and Figure 1, p. 13, 14 and 15.
6. Ibid, Figure 4, p. 25.
7. Ibid.
8. Ibid, Table 6, p. 24.
9. Ibid, Appendix F.
10. Pima County, *Land Stewardship in Pima County, Sonoran Desert Conservation Plan*, February 2000, p. 1.
11. Ibid, Figure 2, p. 8.
12. Ibid, p. 4.
13. Ibid, Figure 1, p. 5.